

# Scleral Fixation of Iris Diaphragm Intraocular Lens in Patients with Traumatic Aniridia

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## Introduction

Ocular trauma frequently causes lens and iris injuries, which may include traumatic cataracts, lens dislocation or subluxation, combined with complete or partial aniridia, or traumatic mydriasis [1].

The loss of the iris diaphragm function leads to spherical and chromatic aberrations, glare, significant photophobia, cosmetic defect, photopic retinal damage, and low visual acuity (VA) after trauma [1].

Many treatment options have been suggested to such patients; such as corneal tattooing, colored contact lenses, iridoplasty, and lid surgery [2]. Since its development by Sundmacher et al.<sup>3</sup> in 1991, the black diaphragm intraocular lens has provided another treatment option to deal with both problems of aphakia and aniridia.

However insertion of such an intraocular lens (IOL) with an optical diameter that needs a 10 mm incision in an already traumatized eye is often challenging.

In this prospective study we evaluated the clinical outcomes of 11 patients with traumatic aniridia and aphakia with no, or insufficient capsular support, who were treated with scleral fixation of a black diaphragm intraocular lens.

## Material and Methods

Eleven eyes of eleven patients were included in this study, from February 2009 to December 2010, at the Armed Forces Hospital, King Abdul-Aziz Naval Base, Saudi Arabia. The study was approved by the ethical and research committee in the hospital.

Eight patients were males and three were females, their age ranged from 16 to 51 years (mean 24.4 years), the patients had previously repaired penetrating eye injuries in other hospitals with aphakia and traumatic aniridia, except 2 patients who had non-penetrating injuries with subluxated crystalline lens and traumatic mydriasis treated by intracapsular cataract extraction. All patients were treated more than 6 months previously.

The inclusion criteria for scleral fixation of an iris diaphragm lens were, aniridia or traumatic mydriasis, the absence of sufficient capsular support for IOL implantation, and normal intraocular pressure (IOP) (< 21 mmHg) with no intervention. Patients with elevated IOP were excluded from the study as well as patients who needed antiglaucoma medication to control the IOP.

Preoperative assessment included VA examination using Snellen's chart, slit lamp examination, ocular tension measurement using Goldmann applanation tonometer, gonioscopy, fundus examination, biometry and B-scan ultrasonography.

Informed consent was obtained from every patient.

Retrobulbar anesthesia or general anesthesia was done, according to patient's preference after discussing the advantages and disadvantages of each type with the patient.

A conjunctival incision was done from 8 to 4 o'clock. Tenon's fascia was

dissected and sclera exposed, twelve marks were made on the cornea with a radial marker used in radial keratotomy to ensure accurate suture placement for lens centration. A 10.0 mm mid limbal lamellar incision was made without entering the eye. Scleral flaps were prepared at 2 o'clock and 8 o'clock for covering the suture for IOL fixation.

All eyes received a black diaphragm polymethyl methacrylate (PMMA) IOL (67G, Morcher GmbH) with an overall diameter of 12.5 mm. Each end of the C-shaped haptics has an eyelet for suture fixation. The 10.0 mm diameter optic has a 5.0 mm clear central optical zone surrounded by a peripheral diaphragm of black PMMA (Figure 1).

Anterior vitrectomy was done for all patients, followed by scleral fixation of the intraocular lens using the ab-externo approach.

A 10-0 polypropylene double-arm 12-inch suture was passed into the anterior chamber under the 8 o'clock scleral flap and pulled out under the 2 o'clock scleral flap guided by a 30 gauge needle, both 1.0 mm posterior to the limbus. If residual iris was present, the suture was passed behind the iris remnant. The eye was then entered with a 3.2 mm keratome through the lamellar incision; viscoelastic material was injected into the anterior chamber. The polypropylene suture was retrieved through the superior limbal incision using a Sinski hook. The suture was cut in the middle, and the cut ends were secured to the respective eyelet. The mid limbal incision was opened to create a 3 step 10.0 mm long incision for IOL insertion.

After the IOL was implanted in the ciliary sulcus, its position was

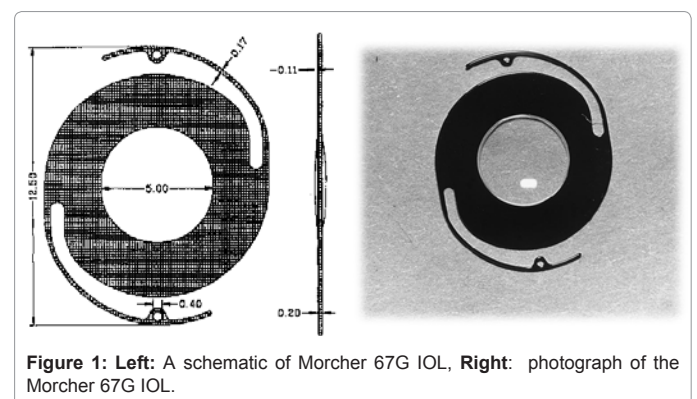


Figure 1: Left: A schematic of Morcher 67G IOL, Right: photograph of the Morcher 67G IOL.

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Patient	preoperative VA	postoperative VA	iris defect (clock hours)	IOL position	IOP Preoperative (mmHg)	IOP Postoperative (mmHg)
1	CF 50 cm	0.15	6	well centered	14	17
2	0.05	0.7	4	well centered	16	16 TR
3	HM	0.3	9	well centered	17	19 TR
4	HM	0.5	5	well centered	13	12
5	0.1	1.0	12	well centered	18	15
6	0.05	0.5	7	well centered	15	19 TR
7	CF 1 meter	0.3	10	well centered	19	20
8	0.2	0.5	8	well centered	14	12
9	0.1	0.9	12	well centered	10	11
10	0.05	0.25	10	well centered	11	18 TR
11	0.1	0.8	8	Well centered	14	18

TR= glaucoma treatment required, CF=counting fingers, HM=hand movement, VA= visual acuity, IOL= intraocular lens, IOP=intraocular pressure

Table 1: Preoperative and postoperative patients' data.

	Mean	SD	Standard error mean	T value	P Value
Preoperative VA	0.0929	.05345	.02020	5.2	P<0.001 HS
Postoperative VA	0.6643	.26254	.09923		
Preoperative IOP	14.6364	2.76668	.83419	1.6	p>0.05 NS
Postoperative IOP	16.0909	3.17662	.95779		

HS= Highly Significant, NS= Non Significant, SD= standard deviation

Table 2: Comparison between the pre- and post-operative visual acuity (VA) and the intraocular pressure (IOP).

adjusted. The IOL was secured to the sclera under the scleral flaps by tying the polypropylene suture. The superior incision and the scleral flaps were closed with 10-0 nylon sutures. Residual viscoelastic material was removed by irrigation aspiration.

The conjunctiva was closed with 8-0 virgin silk sutures. Dexamethasone 2.5 mg and tobramycin 20000 units were injected subconjunctivally, and the eye was patched.

Postoperatively, patients were seen daily for the first 3 days, after 1 week, after 2 weeks, after 1 month, and monthly for 3 months. Then every 3 months till completion of 1 year of follow up.

Post-operative medication was in the form of topical steroids and topical antibiotics 4-6 times daily, gradually tapered over a period of 6 to 8 weeks.

Topical anti-glaucomatous medications were added in eyes with elevated ocular tension > 21 mmHg.

Postoperative examination included VA examination using Snellen's chart, slit lamp examination, ocular tension measurement using Goldmann applanation tonometer, and fundus examination. Ultrasound biomicroscopy was done to all patients to assess the position of the intraocular lens.

## Results

Preoperative and postoperative patients' data are summarized in Table 1.

Glare and photophobia were improved in all patients when asked by a questionnaire after surgery.

The preoperative VA ranged from Hand motion to 0.2. The mean best corrected VA improved from 0.09 preoperatively to 0.66 postoperatively which was statistically significant (Table 2, Figure 2), the best corrected postoperative VA was 0.5 (6/12) or better in 7 patients

The intraocular lenses were well centered in all patients, documented by ultrasound biomicroscopy, which showed the haptics being in the ciliary sulcus, or slightly posterior to it (Figure 3).

Two patients had fibrinous reaction in the anterior chamber postoperatively; one of them had associated vitreous reaction, which resolved with intensive topical steroids over the following days, and systemic steroids in the other patient who had posterior segment reaction as well. The rest of the patients showed mild to moderate postoperative reaction with flare and cells not exceeding ++, which resolved after 4-8 weeks.

None of the eyes developed hyphema or vitreous hemorrhage intra- or postoperatively.

Five eyes developed elevated IOP in the immediate postoperative period including both eyes that had fibrinous reaction; this was controlled with topical timolol 0.5% and dorzolamide, and diamox 250 mg tablets every 8 hours. The IOP in these five eyes was controlled within the first week. Three eyes did not need any more antiglaucoma medication to control the IOP during the 1 year follow up period, while antiglaucoma medication needed to be continued in the other 2 eyes, one of those eyes had a fibrinous reaction in the early postoperative period.

During the course of the follow up, 4 patients (36%) needed topical anti-glaucoma therapy to control the IOP below 21mmHg, two of these 4 eyes were in the group that had elevated IOP in the immediate postoperative period; one of these 2 patients had fibrinous reaction.

The other 7 eyes had IOP <21 mmHg with no medications throughout the follow up period.

At the end of the follow up period the difference between pre- and postoperative IOP was insignificant (Table 2, Figure 4).

The mean iris defect was  $8 \pm 2.6$  (SD) in clock hours, there was no statistically significant correlation between the iris defect and the IOP ( $r=0.01$ ,  $p>0.05$ ), no statistically significant correlation between the iris defect and the VA ( $r=0.20$ ,  $p>0.05$ ) was found as well (Figure 5).

## Discussion

The occurrence of traumatic aniridia and cataract are commonly seen in penetrating eye injuries. The use of a standard IOL implantation

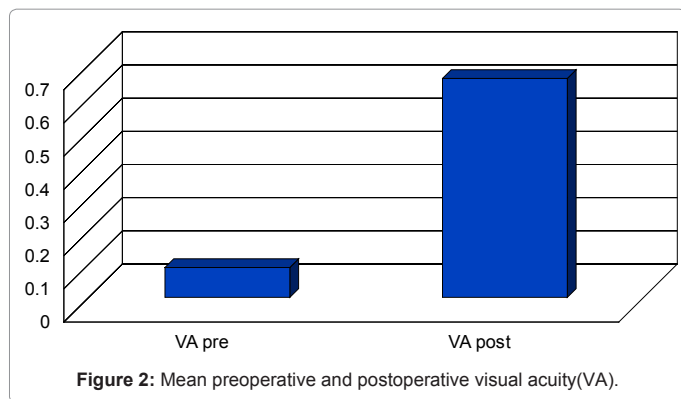


Figure 2: Mean preoperative and postoperative visual acuity (VA).

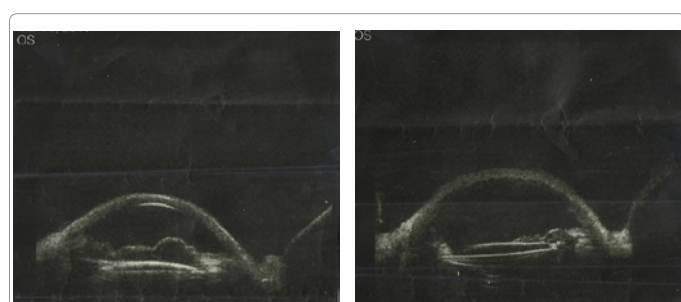


Figure 3: Ultrasound biomicroscopy showing a well centered sclerally fixed intraocular lens. Left; fibrinous reaction in the anterior chamber, Right; 1 week later fibrinous reaction resolved.

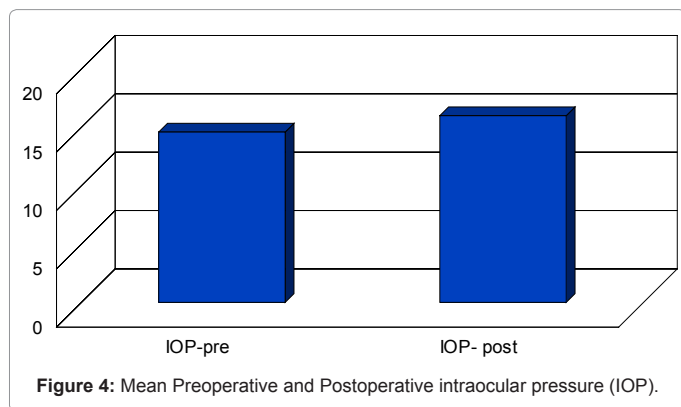


Figure 4: Mean Preoperative and Postoperative intraocular pressure (IOP).

with or without scleral fixation improves the vision<sup>4, 5</sup>, however the problem of photophobia and glare remain an issue. The use of a special black diaphragm lens helps in relieving photophobia and glare, in addition to improving vision by both correcting the refractive error and reducing glare [3].

In this study we report the use of the black diaphragm IOL to manage patients who had penetrating ocular injuries resulting in aphakia and different degrees of traumatic aniridia or traumatic mydriasis.

Seven (63%) of the patients included in this study had significantly better VA postoperatively.

All of the patients experienced improvement of the photophobia and glare postoperatively.

None of the patients in this study developed hyphema or vitreous hemorrhage; this may be attributed to the placement of the IOL scleral fixation sutures at 2 and 8 O'clock position. Hyphema and vitreous

hemorrhage may result from damage to ciliary body and anterior ciliary vessels during IOL suturing, so it is important to avoid the 3-9 O'clock position or the 12-6 O'clock position [6].

In our study one patient had severe anterior segment reaction, and another patient had severe anterior and posterior segment reaction in the immediate postoperative period. Sundmacher et al. [3] reported slight persistent intraocular inflammation after implantation of a black diaphragm IOL in all of the 8 eyes included in their study, which was more obvious in traumatic cases as they reported [3].

Thompson et al. [7] reported 2 cases of persistent postoperative inflammation; one of which had presumed infective endophthalmitis with an acute presentation, and the other had associated vitreous hemorrhage. When the vitreous hemorrhage resolved the anterior chamber activity resolved as well. Burk et al. [8] reported only one case of mild persistent inflammation in their series of 25 patients.

Mild postoperative inflammation persisted in 5 out of 6 cases for a period of 3 to 5 weeks in a study done by Omulecki and Synder [9]. In another study the authors reported that Postoperative inflammation resolved in their series of 15 patients within 2 weeks with topical steroids [6].

The coexisting ocular trauma, the tissue defects from the penetrating injury, the 10 mm large incision to implant the IOL, the relatively prolonged time of surgery, and the excessive manipulations may all contribute to this intraocular inflammation which was extensive in 2 cases in this study, This justified the use of topical steroids for 6-8 weeks, and systemic steroids in one case with posterior segment inflammation.

Another commonly reported complication of black diaphragm IOL implantation is elevated IOP. Thompson et al. [7] observed 2 cases of secondary glaucoma in seven cases, which was controlled with topical treatment or surgery. Reinhard et al. [10] reported chronic IOP elevation in 8 of 19 eyes with traumatic aniridia; 4 with preexisting glaucoma and 4 developed secondary glaucoma postoperatively. In 2 eyes, glaucoma could only be controlled by trabeculectomy, cyclodestruction, and explantation of the aniridia IOL. Omulecki and Synder [9] had a series of 6 cases of traumatic aniridia managed by black

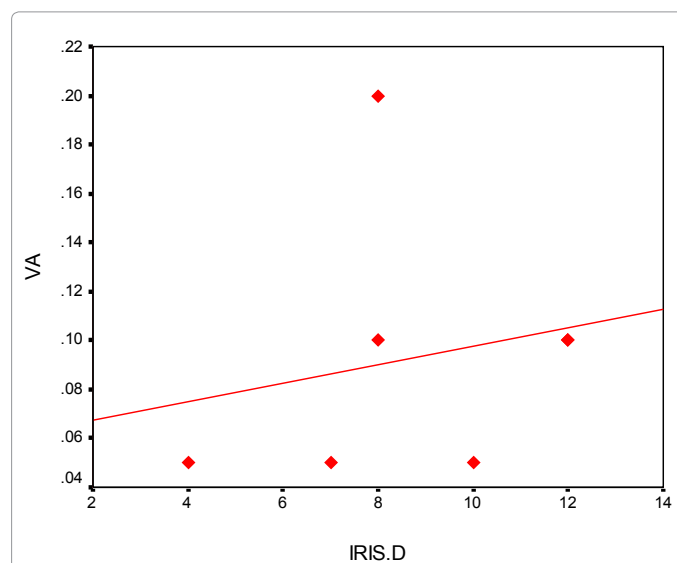


Figure 5: Relation between the extent of the iris defect and the visual acuity (VA).

diaphragm lens implantation, of these 6 cases 2 cases had elevated IOP pre- and postoperatively and 1 developed postoperative IOP elevation treated by topical anti-glaucoma therapy.

In 2003 Dong et al. [6] reported a series of 15 eyes in which 5 eyes had elevated IOP, 4 were controlled medically while one needed selective laser trabeculoplasty.

In 2010 Dong et al. [2] reported a long term outcome of black diaphragm intraocular lens implantation in traumatic aniridia. They observed that “the IOP remained normal or was controlled within the normal range with medical intervention in 14 out of 18 eyes while refractory glaucoma developed in 4 eyes 6-36 months after surgery and could not be controlled by medication and surgical intervention”.

In this study, five patients developed increased IOP in the immediate postoperative period, two of these eyes continued to be controlled by topical antiglaucoma treatment. Topical antiglaucoma therapy was needed to control the IOP in four patients throughout the follow up period.

Many causes may contribute to the development of glaucoma after black diaphragm lens implantation in traumatic aniridia; among these causes is the preexisting trauma, the large IOL especially if not properly fixated.

The mechanism by which the black diaphragm IOL causes glaucoma is still not clear; it may be due to direct compression of the trabecular meshwork by the haptics, or by obstructing aqueous outflow by the larger black diaphragm IOL with more rigid haptics. This was proposed by Reinhard et al. [10] and Aslam et al. [11] especially when they observed that the rise in the IOP happened immediately post operatively.

In our study the haptics were located at or slightly posterior to the ciliary sulcus which decreases the factor of direct compression to the trabecular meshwork, therefore we suggest other mechanisms involved in the IOP elevation in addition to the trabecular meshwork compression. These mechanisms may be in the form of friction between the larger and heavier than standard black diaphragm lens and the ciliary body causing mild anterior uveitis, or friction with the trabecular meshwork causing its eventual damage. This may explain the occurrence of latent cases of secondary glaucoma which occurred in our series as well as the series by Dong et al. [2].

Reinhard et al. [10] and Dong et al. [2] recommended tight scleral suturing rather than sulcus implantation of the black diaphragm lenses to avoid the excessive movement of the lens, this study agrees with this suggestion.

The fact that all of our cases had to be scleral fixated due to insufficient capsular support, may have contributed to the slightly lower incidence of glaucoma in 4 out of 11 (36%) cases when compared with the deterioration and development of glaucoma in 8 out of 19 (42%) eyes reported by Reinhard et al. [10], especially when putting into consideration that their cases had congenital aniridia with added preexisting angle anomalies.

In conclusion, the black diaphragm IOL seems to be a good option for the management of traumatic aniridia and aphakia, visual results are very good, post-operative complications especially glaucoma are still a concern. Changes in the IOL design making it less bulky, tight scleral fixation of the IOL, and securing the lens in a slightly more posterior position, may help in reducing glaucoma.

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