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Penetrating Keratoplasty and Artisan Iris-Fixated Intraocular Lens Implantation in the Management of Aphakic Bullous Keratopathy

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Abstract

Objective:
To evaluate the safety and efficacy of aphakic bullous keratopathy (ABK) management with combined PK, anterior vitrectomy, angle synechiolysis, and Artisan intraocular lens implantation.

Methods:
Fourteen eyes of 11 patients underwent the procedure. Mean follow-up was 12–36 months (mean 24) for visual acuity (Va), refractive error (RE), intraocular pressure (IOP), tonography, graft clarity, intraocular lens centration, and any complications.

Results:
The postoperative mean values were: Va improved from 20/400 to 20/50, spherical RE was –2.65 diopters, IOP was 17.5 mmHg, tonography improved by 55%, all grafts were clear; no IOL decentrations or serious complications were noted.

Conclusions:
This iris-fixated intraocular lens appears to offer simplicity in implantation and may be combined with PK, anterior vitrectomy, and angle synechiolysis. It may be a safe and effective alternative with PK in the management of ABK.

Key Words: aphakic bullous keratopathy, penetrating keratoplasty, IOL implantation

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Although the prevalence of aphakic bullous keratopathy is diminishing, surgical management includes penetrating keratoplasty and, depending on the underlying pathology, the possibility of simultaneous anterior vitrectomy, synechiolysis, and intraocular lens implantation.[1–4]

The options of this latter step include an anterior chamber intraocular lens, angle-supported,[5–8] a posterior chamber intraocular lens that could be implanted with transscleral fixation,[9–16] support of the lens by suturing on the overlying iris,[17,18] or with support from the Soemmering ring (when that is present).[19,20]

The Artisan intraocular lens (Ophtec, Groningen, Netherlands) is a single-piece polymethyl methacrylate anterior chamber implant, also called an iris claw lens because of its mechanism of fixation onto the midperipheral iris (Fig. 1). This lens has been used in the past in combination with penetrating keratoplasty to manage aphakic bullous keratopathy.[21,22]

We found, in our international clinical practice, the initial use of this implant to be a safe and effective in combined PK and intraocular lens implantation for the management of ABK in several cases.

We therefore conducted this study to evaluate a series of consecutive procedures in which an iris-fixated intraocular lens was implanted during the combined transplantation procedure.

METHODS

This study was performed in our facility in Athens, Greece. The use of the Artisan lens for aphakia has been approved by the European Commission (CE mark).

Fourteen eyes of 11 consecutive patients who were diagnosed with aphakic bullous keratopathy within a period of 1½ years underwent the following combined procedures:

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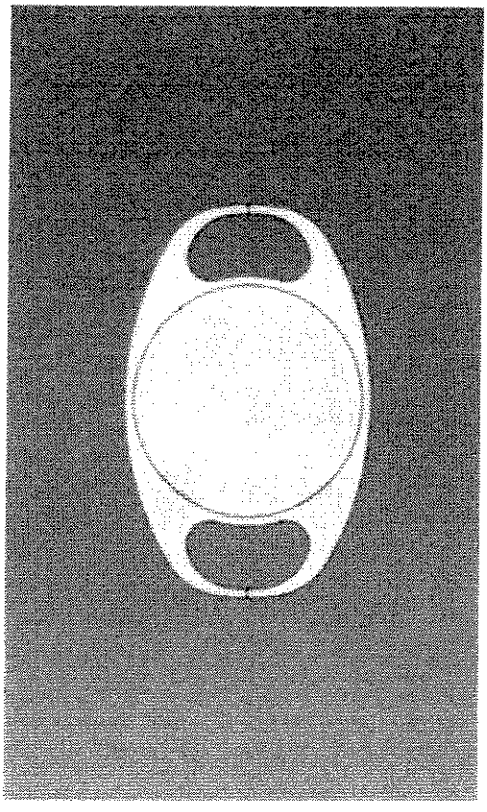

FIGURE 1. The Artisan aphakia lens.

1. Penetrating keratoplasty
2. Anterior vitrectomy
3. Synechiolysis of the angle with surgical dehiscence of the angle synechiae intraoperatively, either directly, with the use of Tenant forceps, or with the use of viscoelastic directed toward the angle structures
4. Iridoplasty with the use of 1 to 3 10-0 proline sutures as needed to obtain a centrally placed pupil
5. Artisan iris lens fixation before graft suturing

The Artisan lens was enclaved by an open-sky approach on the midperipheral iris. The term *enclavation* is used to describe the entrapment of a fraction of the midperipheral iris within the haptics of this intraocular lens. This maneuver is relatively simple and not very traumatic for the iris tissue. The ability to perform the enclavation through the open-sky cornea opening before placement of the donor tissue simplifies this process further. The enclavation was performed at approximately an 8.5-mm diameter distance at the iris periphery, and as mentioned above, it is quite simple when performed open-sky. All cases received a postoperative regimen of topical ofloxacin QID for 1 month and prednisolone acetate 1% QID for 1 month. These topical medications were tapered over 3–4 months as needed.

We evaluated the visual acuity, refractive error, intraocular pressure, C-value tonography at a 2 minute examination (tonography performed with the Mentor classic pneumotonometer), graft clarity, intraocular lens centration in regard to the effective pupil (measured at the slit lamp postoperatively), and possible complications.

Follow-up was 12 to 36 months (mean 24 months).

RESULTS

In the postoperative management of these cases we accumulated the following data.

The mean age was 80.5 years (68–92). There were 8 right eyes and 6 left.

Mean visual acuity improved from best-corrected 20/400 before surgery to 20/50 following the surgery. Figures 2, 3, and 4 demonstrate clinical pictures of 3 patients from this group. The average spherical refractive error was −2.65 diopters in this group. The

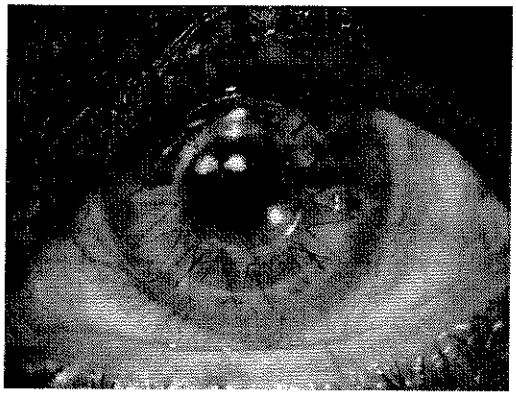

FIGURE 2. A clinical picture of patient 6's OS 6 months following the procedure.

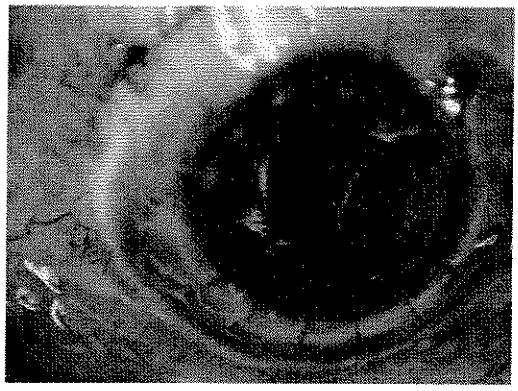

FIGURE 4. Clinical picture of patient 10's OD. The IOL is well positioned, and the iridoplasty is visualized as well.

mean intraocular pressure was 20.5 mmHg before the surgery (range 16–26) and 17.5 mmHg (range 12–22) postoperatively. Two eyes in this study were treated additionally in the postoperative period with a β blocker for appropriate intraocular pressure control in comparison to 6 eyes preoperatively.

The mean tonographic C-value at the 2-minute examination for this group of eyes preoperatively was 0.15 mL/mm mmHg. This improved to a mean of 0.22 mL/mm mmHg (55% improvement). At the interval of follow-up, all grafts were found to be clear, and no rejection episodes were noted. Regarding intraocular lens centration, no significant decentrations of the intraocular lens of more than 1 mm in regard to the iris pupil were noted in this small group of patients. One eye presented with 5% hyphema in the first postoperative week, which was attributed to the angle synechiolysis intraoperative manipulations and cleared without further treatment. No other complications were noted in these patients other than the need for some topical agents for adequate intraocular pressure control, as mentioned previously. Detailed results for each case are noted analytically in Table 1.

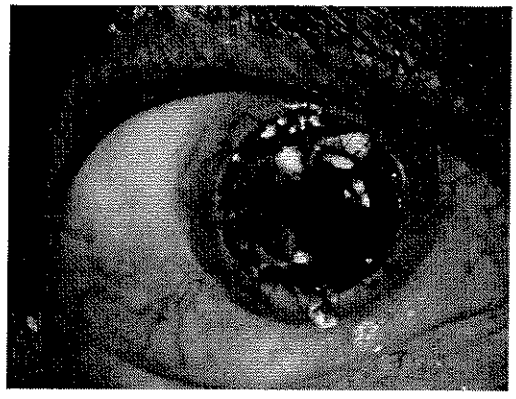

FIGURE 3. Clinical picture of patient 4's OD 11 months postoperatively.

CONCLUSIONS

We decided to evaluate several glaucoma parameters because aphakic bullous keratopathy is commonly associated with glaucoma[23,24] for several reasons:

1. The presence of vitreous in the anterior chamber may reduce outflow facility.
2. The disruption of the iris-lens diaphragm may cause significant anterior posterior synechiae and elimination of a significant part of the function of the trabecular meshwork.
3. Intraoperative events during the original intracapsular cataract extraction may have resulted in damage to the trabecular meshwork's ability to transduce aqueous.
4. Coinciding open angle-glaucoma, either from chronic topical corticosteroid use or from primary open-angle causes, may contribute to glaucoma pathology.

Glaucoma in ABK is quite difficult to manage because of poor visualization of the optic nerve and difficulty in obtaining accurate intraocular pressure measurements on an edematous cornea, and its diagnosis becomes difficult because of the corneal edema.

The intraocular pressure is usually undermeasured, as is common in edematous corneas, with applanation tonometry. It is difficult to evaluate the optic nerve through the optic media, which usually is clouded in ABK, and obviously, it is difficult to evaluate other clinical signs of glaucoma, such as visual field contrast and sensitivity and other retinal and optic nerve head imaging diagnostics.

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TABLE 1. Patient Data

Pt	Age	Eye	Va Pre	Va Post	Sp RE	IOP Pre	IOP Post	C Pre	C Post	Clarity	Centr	Complications
1	78	OD	0.05	0.4	−2	21	17	0.12	0.17	3	Yes	None
2	82	OD	0.1	0.4	−1.5	22	16	0.15	0.15	4	Yes	None
3	87	OS	CF	0.5	−2.75	20	18	0.1	0.24	3	Yes	None
4	76	OD	0.1	0.5	−1	16	15	0.14	0.2	3	Yes	None
5	68	OS	0.1	0.8	1	26	17	0.15	0.22	4	Yes	None
6	77	OD	0.1	0.33	−2.5	19	16	0.16	0.3	4	Yes	None
		OS	CF	0.4	−2.5	21	20	0.17	0.27	3	Yes	None
7	88	OD	0.1	0.4	−3.75	24	21	0.16	0.24	4	Yes	None
8	92	OD	0.05	0.33	−3	16	15	0.15	0.15	3	Yes	None
9	72	OS	0.13	0.4	−2.75	18	17	0.2	0.22	4	Yes	None
10	81	OD	0.05	0.2	−3.5	25	18	0.21	0.25	3	Yes	None
		OS	0.1	0.2	−4	22	17	0.13	0.21	4	Yes	None
11	85	OS	0.05	0.4	−4.5	18	18	0.12	0.22	3	Yes	None
		OD	CF	0.33	−4.5	19	20	0.15	0.24	3	Yes	None
Mean	80.5		0.08	0.4	−2.65	20.5	17.5	0.15	0.22	3.4		

Va pre, preoperative BCVA; Va post, postoperative BCVA; Sp RE, spherical postoperative refractive error; IOP pre/IOP post, preoperative and postoperative IOP in mmHg; C pre/ C post, preoperative and postoperative C value of outflow facility; Clarity, postoperative.

We therefore found in this small clinical study that Artisan lens iris-supported implantation in conjunction with penetrating keratoplasty may be a safe and effective alternative for the surgical management of aphakic bullous keratopathy.

This technique offers several advantages. First, the intraocular lens implantation is brief and simple. When performed open-sky, intraocular lens exchange may be a lengthy procedure, especially when transscleral intraocular lens fixation or Soemmering ring fixation is attempted. The additional operative time may add to the possibility of intraoperative complications.[4]

There are relatively few posterior chamber manipulations during the lens implantation, which reduces the possibility for retinal detachment and vitreous hemorrhage.

The Artisan aphakia intraocular lens, although an anterior chamber lens, does not support itself in the angle and therefore may offer the advantage of less possibility of outflow facility inhibition through direct occlusion of the trabecular meshwork or secondary occlusion by anterior-posterior synechiae forming around the haptics. Additionally, the lens is placed "flush" with the iris, maximizing its distance from the corneal endothelial surface and therefore reducing as much as possible for an anterior chamber intraocular lens the possibility of graft endothelial damage.[6]

There are some potential disadvantages in the surgical placement of this intraocular lens followed by the suturing of a penetrating cornea graft.

There is potential difficulty in having the lens between the iris and the cornea, especially for surgeons who may not be completely adept in suture placement. The donor cornea could be forced against the intraocular lens intraoperatively, during the suturing process, causing graft endothelial damage.

Potential postoperative angle synechiae formation following this technique may cause secondary displacement of the iris and the intraocular lens toward the graft endothelial surface.

In regard to glaucoma related to aphakic bullous keratopathy and its management, the anterior vitrectomy that is performed during the procedure would provide a significant aid to reestablishing normal outflow facility, as well as the synechiolysis performed during the procedure.[7] At this point, placing

an iris-supported IOL instead of an angle-supported anterior chamber IOL may avoid putting a further burden onto the trabecular meshwork. The observation of relative improvement of the outflow facility noted in this small group of patients may be a result of the intraoperative manipulations of anterior vitrectomy, synechiolysis, lens implantation, closer follow-up, improved patient compliance to topical medications, or other unknown factors not studied herein.

This small pilot study suggests the safety and efficacy of the use of the Artisan aphakia intraocular lens in conjunction with penetrating keratoplasty in the management of ABK. It may provide an alternative for the cornea surgeon. Further, larger, and randomized studies may aid in establishing the validity of these results.

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