Argon Laser Iridoplasty for Optic Obstruction of Boston Keratoprosthesis

Joann J. Kang, MD; Norma Allemann, MD; Maria Soledad Cortina, MD; Jose de la Cruz, MD; Ahmad A. Aref, MD

The Boston keratoprosthesis (KPro) has been used successfully in eyes with poor prognosis for conventional penetrating keratoplasty. However, postoperative changes in iris configuration after Boston KPro may occur, including iris obstruction of the Boston KPro, limiting visual potential in otherwise successful transplants. We describe our technique of argon laser iridoplasty after Boston KPro as a safe and effective procedure to treat visually significant optic obstruction and as a less-invasive alternative to surgical intervention.

METHODS

Our technique for argon laser iridoplasty after Boston KPro is similar to the previously described argon laser peripheral iridoplasty (ALPI) procedure with several modifications. In brief, the steps are as follows: (1) pretreatment with 1 drop of topical brimonidine tartrate is administered approximately 30 minutes before treatment to blunt an elevation of intraocular pressure (IOP) after use of the laser, (2) topical anesthesia (1 drop of proparacaine hydrochloride) is administered and no contact lens is required, and (3) the argon laser is set to produce contraction burns, which comprise low power (200-400 mW), long duration (1.0 second), and large spot size (500 µm). This procedure draws the surrounding iris tissue toward the burn site and contracts the iris at the site of treatment. Visible stromal contraction is immediate and power should be adjusted as necessary, with lighter irides generally needing more power than darker ones. If bubble formation occurs or there is pigment release, the power is too high.

The aiming beam should be directed just peripheral to the Boston KPro optic in the area of obstruction to cause optimal contraction of iris stroma away from the optical window. The fewest number of spots are used to enlarge and shape the effective pupil as desired. Avoidance of large iris radial blood vessels and overtreatment with contiguous placement of treatment burns is recommended to prevent iris necrosis.

Immediately after the laser treatment, 1 drop of topical brimonidine should be adminis-
Topical corticosteroids should be used 4 times daily for 3 to 5 days, and IOP should be monitored as it is after any other anterior segment laser procedure. Elevation of IOP after the laser procedure should be treated with IOP-lowering agents.

RESULTS

Two patients underwent successful procedures using the technique described herein. The first patient, a 74-year-old African American man with a chemical burn injury and secondary glaucoma, underwent an uneventful Boston KPro type 1 procedure with adequate centration and iris sphincterotomies in 4 quadrants. The iris was first observed at the superonasal optic margin 3 months postoperatively but did not cause visual obstruction, with best-corrected visual acuity (BCVA) of 20/50. However, by 2 years postoperatively, progressive iris migration obstructed the visual axis clinically by 1.3 mm at the greatest diameter in the nasal and superotemporal quadrants, contributing to decreased BCVA of 20/100 and limiting retinal and glaucoma surveillance (Figure 1A). A trial of cycloplegics to relieve the iris obstruction was unsuccessful. Anterior segment optical coherence tomography (AS-OCT) (Visante; Carl Zeiss Meditec) revealed iris extension between the 45° and 225° meridians, progressing radially and centrally to the posterior aspect of the Boston KPro optic, with a measured iris–Boston KPro touch of 1.28 mm in the 90° meridian and 1.32 mm in the 180° meridian with a thickness of 0.31 mm (Figure 1C). The patient underwent argon laser iridoplasty for visually significant iris obstruction, with only 0.27 mm of iris–Boston KPro touch remaining superiorly at the optic margin as measured by slitlamp biomicroscopy and 0.18 mm of iris–Boston KPro touch after treatment (Figure 1B-D). There were no significant changes in anterior chamber depth or angle as measured by AS-OCT, and the Goldmann visual field remained generally full to a large target, V-4-e (Figure 1E and F). After laser treatment, BCVA improved to 20/70, IOP improved.

Figure 1. Improved iris-keratoprosthesis (KPro) optic obstruction after argon laser peripheral iridoplasty. A, Slitlamp photograph of the first patient before argon laser iridoplasty, with the iris obstructing the nasal and superotemporal Boston KPro optic. B, Slitlamp photograph of the patient, with minimal iris remaining in the superonasal quadrant of optic. C and D, Before laser and after laser anterior segment optical coherence tomography at the 90° meridian with radially measured iris–Boston KPro touch of 1.28 mm (before) and 0.18 mm (after) in the visual axis. E and F, Before laser and after laser Goldmann visual field demonstrating stable peripheral field with V-4-e and III-4-e targets. BP indicates back plate; CO, donor cornea.
remained controlled, and appropriate glaucoma and retinal monitoring became possible.

The second patient, a 66-year-old white woman with pseudophakic bullous keratopathy, multiple failed penetrating keratoplasties, and secondary glaucoma, underwent concurrent Boston KPro type 1 and pars plana tube-shunt placement. The iris was initially observed at the inferior optic margin 3 months postoperatively, but it did not cause visual obstruction, with BCVA 20/50. However, by 4½ years postoperatively, the patient’s BCVA declined to 20/800, likely due to glaucoma progression and progressive central iris migration into the visual axis. The iris obstructed the inferior optical axis by 0.98 mm as measured clinically at the slitlamp and by 0.70 mm of iris–Boston KPro touch radially at the 225° meridian and 0.67 mm at the 270° meridian with 0.28-mm thickness as measured by AS-OCT (Figure 2A-C). A trial of cycloplegics to relieve the iris obstruction was unsuccessful. The patient underwent argon laser iridoplasty for visually significant optic obstruction, and less than 0.5 mm of iris remained in the visual axis clinically by slitlamp measurement and 0.29 mm of iris–Boston KPro touch remained at the 225° meridian by AS-OCT after the procedure (Figure 2B-D). The woman noted a significant improvement of both visual acuity and visual field, with measured BCVA of 20/70 and expansion of the inferior field on testing with Humphrey visual field 24-2 threshold protocol with size V stimulus (Figure 2E and F). The superior visual field was restricted secondary to upper eyelid ptosis and, at the time of writing, the patient was scheduled to receive blepharoplasty, which will likely further improve the peripheral visual field. However, although Humphrey visual field examinations were repeated with similar results, interpretation of the visual fields is limited secondary to fixation losses of 14/25 and 11/21 before and after laser use, respectively. The anterior chamber depth and angle remained stable.

**COMMENT**

Postoperative changes in iris configuration may be observed after Boston KPro surgery. In our experience, despite adequate centration and, in select cases, surgical iris sphincter cuts in 4 quadrants, iris–Boston KPro interaction can occur and may have visual significance. We describe 2 cases of iris obstruction of the Boston KPro optic, limiting visual potential and glaucoma and retinal evaluation. Although the exact mechanism is not known, it is pos-
sible that changes in iris configuration causing optic obstruction may be a result of decentered corneal trephination or inadequate or uneven sphincterotomies, causing asymmetrical iris retraction and advancement. In addition, a crowded anterior segment and associated postoperative inflammation, adhesions, and scarring may contribute to abnormal iris configuration.

Visualization of the Boston KPro interaction with surrounding anterior segment structures using conventional slitlamp examination is often challenging; consequently, irido-Boston KPro dynamics are poorly understood. However, recent studies have demonstrated that AS-OCT can adequately image the components of the assembled Boston KPro in vivo as well as provide visualization of the anterior chamber, iris, angle, and anatomic relation of Boston KPro to anterior segment structures, which has proven to be useful in the identification and management of potential postoperative complications. In our patients, AS-OCT enabled visualization of iris behavior in cross section because the view behind the cornea through slitlamp biomicroscopy is limited due to vascularized and opacified donor tissue. The AS-OCT can also be used as a tool to more accurately quantify the amount of iris-Boston KPro touch and obstruction of the optical axis as well as tissue retraction after laser treatment.

Our results show that argon laser iridoplasty can provide a definitive treatment for Boston KPro optic obstruction and may be a new indication for this laser procedure. Argon laser peripheral iridoplasty is a well-recognized procedure used to produce contraction burns in the extreme iris periphery to anatomically open the angle and treat angle closure from mechanisms other than pupillary block. Similarly, as in our patients, the photocoagulative effect of the argon laser may be used to contract the stroma and cause retraction of iris tissue away from the Boston KPro optic. Long-term effects of the treatment can be expected; Ritch and colleagues reported that the angle in 87% of eyes with plateau iris syndrome remained open after only 1 treatment of ALPI, with a mean (SD) follow-up time of 78.9 (8) months (range, 72-188 months). Histopathologic examination suggests that the short-term effect of argon laser iridoplasty is related to heat shrinkage of collagen and the long-term effect is secondary to contraction of a fibroelastic membrane in the region of laser application. Complications of argon laser iridoplasty are minimal and include iritis developing after the procedure and a transient elevation of IOP, which are typically responsive to treatment with topical corticosteroids or IOP-lowering agents. Iris atrophy is rare and can be avoided by using the lowest laser power to achieve stromal contraction.

There is also potential for damage to the polymethylmethacrylate Boston KPro optic by argon laser. Whitacre and Rupani reported a case of argon laser–induced melt of a polymethylmethacrylate intraocular lens after indirect laser photocoagulation with a high-power setting (580-770 mW) and application of numerous burns (531 shots) in comparison with the relatively low power (200-400 mW) and few number of burns (average, 18.5 shots) in our technique of argon iridoplasty. The Nd:YAG laser is a more commonly used laser after Boston KPro, and Chak and Aquavella reported a peripheral Nd:YAG “can-opener” approach as a safe and effective method for retroprosthetic membrane removal with no evident damage to the optic. Although both types of lasers may be used, the photocoagulation effect of the argon laser (contraction of tissue and hemaostasis) is better suited for iridoplasty, while Nd:YAG is more effective for photodisruptive activities such as retroprosthetic membrane removal.

In conclusion, we propose a safe, effective, and relatively simple outpatient laser procedure for treatment of visually significant iris optic obstruction after Boston KPro implantation. To our knowledge, this represents the first report describing use of argon laser iridoplasty for this condition; it is a less-invasive alternative to intraocular surgery for repairing visually significant optic obstruction.

Submitted for Publication: January 9, 2012; final revision received February 16, 2012; accepted February 28, 2012.

Correspondence: Ahmad A. Aref, MD, Department of Ophthalmology and Visual Sciences, University of Illinois at Chicago, 1855 W Taylor St, Ste 3.171, Chicago, IL 60612 (aaref@uic.edu).

Author Contributions: The authors had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.

Financial Disclosure: None reported.

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