

Argon laser peripheral iridoplasty — indications and surgical technique

Yolanda Y. Y. Kwong,^{1,2} MRCSEd, Clement C. Y. Tham,^{1,3} FRCS, Robert Ritch,⁴ MD, Jimmy S. M. Lai,^{1,5} FRCS, FRCOphth, Dennis S. C. Lam,^{1,2} FRCS, FRCOphth

¹Department of Ophthalmology and Visual Sciences, The Chinese University of Hong Kong, Hong Kong, China.

²Hong Kong Eye Hospital, Kowloon, Hong Kong, China.

³Queen Mary Hospital, Pokfulam, Hong Kong, China.

⁴The New York Eye and Ear Infirmary, New York, USA.

⁵United Christian Hospital, Kowloon, Hong Kong, China.

Correspondence and reprint requests:

Clement C. Y. Tham, FRCS, Department of Ophthalmology and Visual Sciences, Room 703A, 7/F, Administration Block, Queen Mary Hospital, 102 Pokfulam Road, Hong Kong. Tel: (852) 2855 3788; Fax: (852) 2816 7093; E-mail: clemtham@hkstar.com

Abstract

Argon laser peripheral iridoplasty is a simple and effective means of opening an appositionally closed angle in situations in which laser iridotomy either cannot be performed or does not physically eliminate appositional angle closure because mechanisms other than pupillary block are present. The procedure consists of placing contraction burns in the extreme iris periphery to contract the iris stroma between the site of the burn and the angle, physically pulling open the angle. Argon laser peripheral iridoplasty is useful for reversing an acute angle closure attack, either as a primary measure or when systemic medications fail to control intraocular pressure. This article discusses the indications for and surgical techniques of argon laser peripheral iridoplasty.

Key words: Glaucoma, angle closure, Laser surgery

Introduction

Argon laser peripheral iridoplasty (ALPI) is a simple and effective means of opening an appositionally closed angle in situations in which laser iridotomy either cannot be performed or does not physically eliminate appositional angle closure because mechanisms other than pupillary block are present. The procedure consists of placing contraction burns in the extreme iris periphery to contract the iris stroma between the site of the burn and the angle, physically pulling open the angle (Figure 1).¹⁻⁵ ALPI is extremely useful for reversing an attack of acute angle closure (AAC), either as a primary measure or when systemic medications fail to control intraocular pressure (IOP).

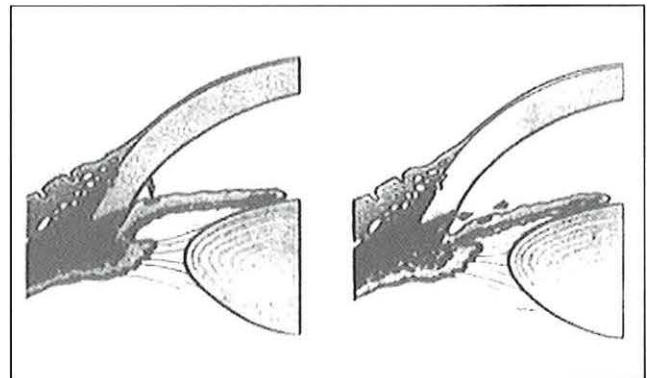


Figure 1. Schematic diagram illustrating how argon laser peripheral iridoplasty contracts the peripheral iris stroma, creating a space between the anterior iris surface and the trabecular meshwork, thereby opening the angle.

extreme iris periphery to contract the iris stroma between the site of the burn and the angle, physically pulling open the angle (Figure 1).¹⁻⁵ ALPI is extremely useful for reversing an attack of acute angle closure (AAC), either as a primary measure or when systemic medications fail to control intraocular pressure (IOP).

Indications

Acute angle closure

An attack of AAC that is unresponsive to medical therapy and in which corneal edema, a shallow anterior chamber, or marked inflammation precludes immediate laser iridotomy,

or which is unresponsive to successful iridotomy, may be broken with ALPI.^{1,6} Circumferential treatment of the iris opens the angle in those areas in which there are no peripheral anterior synechiae (PAS). All published series have reported almost 100% success rates. The effect lasts sufficiently long for the cornea and anterior chamber to clear so that iridotomy can be performed.

ALPI may also be used as primary therapy in eyes with AAC, either with or without preliminary treatment with topical medications.^{1,7-11} Immediate ALPI for acute attacks after initial treatment with pilocarpine 4% and timolol 0.5% has been reported to be successful when given over 180°⁸ and 360° of the peripheral iris.⁷

A more recent randomized controlled trial directly compared ALPI with conventional systemic IOP-lowering medications as the primary treatment for AAC not amenable to immediate laser peripheral iridotomy.¹⁰ Consecutive patients with their first presentation of AAC, with IOPs >40 mm Hg, were recruited. The AAC eye of each consenting patient received topical pilocarpine 4% and topical timolol 0.5%. The patients were then randomized into 1 of 2 treatment groups. The ALPI group received immediate ALPI under topical anesthesia. The medical treatment group was given intravenous acetazolamide, followed by oral acetazolamide, until the IOP normalized. Intravenous mannitol was also administered to the latter group if the presenting IOP was >60 mm Hg.

There were no significant differences between the treatment groups in age, duration of attack, and IOP at presentation. The mean IOP in the ALPI-treated group was reduced from 60.8 mm Hg (SD, 11.6 mm Hg) at presentation to 30.8 mm Hg (SD, 9.5 mm Hg) 15 minutes after ALPI, and 20.6 mm Hg (SD, 10.1 mm Hg) 1 hour after ALPI. The ALPI-treated group had significantly lower IOP than the medically treated group, at 15 minutes, 30 minutes, and 1 hour after the start of treatment (Figure 2). The duration of attack did not affect the efficacy of ALPI in reducing IOP after AAC. No serious laser complications occurred.

It was concluded that ALPI was significantly more effective than conventional systemic medications for reducing IOP in AAC not suitable for immediate laser peripheral iridotomy. ALPI was proposed as a safe and more effective alternative to conventional systemic medications as the primary treatment of AAC.^{10,12} In the mid-term results, there were no statistically significant differences in mean IOP and requirement for glaucoma drugs between AAC eyes treated with ALPI and systemic medications.¹³ However, it should be stressed that since ALPI does not eliminate pupillary block, a laser peripheral iridotomy is still required for AAC eyes.

It is believed that ALPI mechanically pulls open the closed drainage angle, thereby allowing aqueous to escape through the trabecular meshwork. This hypothesis was supported by ultrasound biomicroscopy study.⁷ ALPI may, at least in

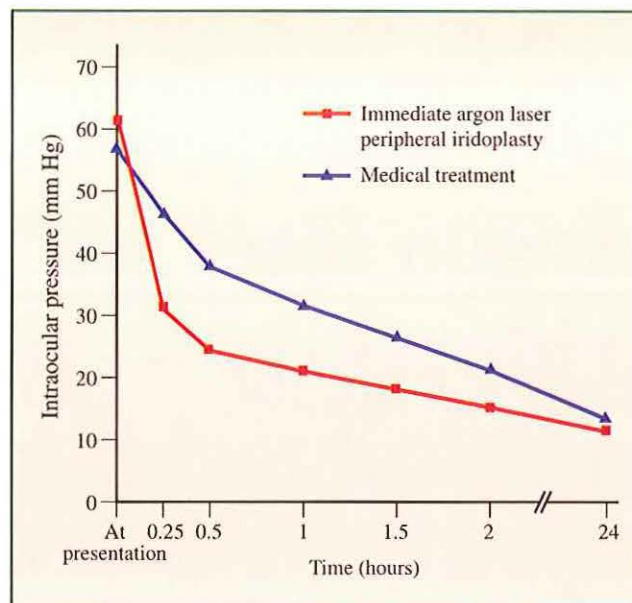


Figure 2. Profiles of mean intraocular pressure before and at various time points after commencement of treatment with argon laser peripheral iridoplasty or conventional systemic intraocular pressure-lowering medications as first-line treatment of acute primary angle closure.

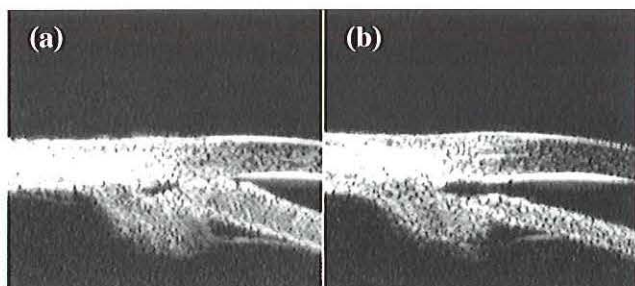


Figure 3. Ultrasound biomicroscopy image of (a) an eye with plateau iris syndrome after laser peripheral iridotomy; and (b) the same eye with plateau iris syndrome after laser peripheral iridotomy and argon laser peripheral iridoplasty to open the drainage angle.

Plateau iris syndrome

ALPI, which compresses the iris root, has shown long-term success for treating eyes with plateau iris syndrome (Figure 3).²¹⁻²³ In one series of 23 eyes with a mean follow-up of 79 months, the angle in 20 eyes (87.0%) remained open throughout follow-up after only 1 treatment.²³ In 3 eyes, there was gradual reclosure of the angle years later, but the angles were readily reopened and maintained by a single repeat treatment. No filtration surgery was necessary for these patients during follow-up. A combined laser technique, with ALPI and sequential laser peripheral iridotomy, has been proposed as a primary treatment for eyes with plateau iris syndrome.²²

Angle closure related to size or position of the lens

Angle closure caused by an enlarged lens or pressure posterior to the lens is not often responsive to iridotomy, although a component of pupillary block may be present and should be eliminated by iridotomy. These types of angle closure include ciliary block, lens intumescence, anterior subluxation of the lens, or anterior lens displacement secondary to ciliary body edema from panretinal photocoagulation or scleral buckling procedures. In situations in which the angle remains appositionally closed after laser iridotomy, the apposition can often be partially or entirely eliminated by iridoplasty.^{3,4}

ALPI is also effective as a primary treatment to break attacks of acute phacomorphic angle closure.^{1,24,25} In a recent study, 10 consecutive patients with acute phacomorphic angle closure and IOP >40 mm Hg were recruited. Each patient received topical atropine 1% and timolol 0.5%, and immediate ALPI as initial treatment. After ALPI, the mean IOP was reduced from 56.1 mm Hg (SD, 12.5 mm Hg) to 37.6 mm Hg (SD, 7.5 mm Hg) at 30 minutes, 25.5 mm Hg (SD, 8.7 mm Hg) at 120 minutes, and 13.6 mm Hg (SD, 4.2 mm Hg) at 1 day. All 10 patients had uncomplicated cataract extraction soon after ALPI. No complications from the laser procedure were encountered.²⁴

In acute phacomorphic angle closure, breaking the attack with ALPI may allow the inflammation and folds in Descemet's membrane to clear, facilitating cataract extraction.

Adjunct to laser trabeculoplasty

If the angle is narrow because of plateau iris configuration or angle crowding, ALPI can retract the iris away from the trabecular meshwork, widening the area to permit trabeculoplasty burns to be placed.^{2,26}

Surgical technique

Pretreatment measures

The procedure is performed on an outpatient basis under topical anesthesia using an Abraham lens. Prior to treatment, pilocarpine 2% or 4% is applied topically to stretch the iris maximally from the iris root to the pupillary border. Apraclonidine or brimonidine is administered before and after the procedure to prevent a laser-induced IOP rise.

Laser parameters

The argon laser is set to produce contraction burns (500 μ m spot size, 0.5 to 0.7 second duration, and, initially, 240 mW power). With the contact lens in place, the beam is aimed at the most peripheral portion of the iris possible (Figure 4). It is useful to allow a thin crescent of the aiming beam to overlap the sclera at the limbus. The patient may be directed to look in the direction of the beam to achieve more peripheral spot placement.

The foot pedal should be pressed for the entire duration of the burn, unless bubble formation and pigment release occur. The contraction effect is immediate and is usually accompanied by noticeable deepening of the peripheral anterior chamber at the site of the burn. A lack of visible contraction and deepening of the peripheral anterior chamber at any site is suggestive of too low power or PAS. If bubble formation occurs or if pigment is released into the anterior chamber, the power should be reduced.

Treatment consists of placing approximately 20 to 24 spots over 360°, leaving approximately 2 spot-diameters between

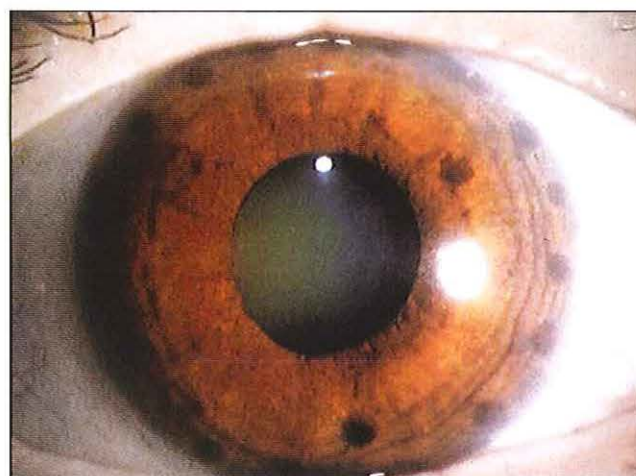


Figure 4. Slit-lamp photograph of an eye with plateau iris syndrome previously treated with argon laser peripheral iridoplasty. The dark round laser marks can be clearly seen on the peripheral iris.

each spot and avoiding large visible radial vessels if possible. Although rare, iris necrosis may occur if too many spots are placed too closely together.

An extremely shallow anterior chamber and corneal edema, do not preclude peripheral iridoplasty. If necessary, glycerine may help to clear the cornea temporarily to facilitate ALPI. If the anterior chamber is very shallow, laser applications should be timed sufficiently apart so that any heat generated can dissipate.

Other published laser settings for this type of burn, usually 200 μm , of 0.1- or 0.2-second duration, and 200 mW power, often provide insufficient contraction and result in bubble formation or pigment liberation into the anterior chamber. When used through the angled mirror of a gonioscopy lens, they are more likely to result in stromal destruction or inadvertent damage to the trabecular meshwork.

When ALPI needs to be repeated because of recurrence of appositional closure at some point after the angle has been initially opened, it is possible to place the contraction burns further peripherally than had been initially possible.

Postoperative treatment

Immediately after the procedure, the patient should be administered 1 drop of topical steroid and apraclonidine or brimonidine. Gonioscopy should be performed to assess the effect of the procedure at a subsequent visit. Patients require topical steroids 4 to 6 times daily for 3 to 5 days. IOP must be monitored postoperatively and patients should be treated if a post-laser IOP rise occurs.

Complications

Mild postoperative iritis is common, seldom lasting more than a few days, and responds to topical steroid treatment. The patient may experience transient ocular irritation.

As iridoplasty is often performed on patients with extremely shallow peripheral anterior chambers, diffuse corneal endothelial burns may occur. Endothelial burns may be minimized by placing an initial contraction burn more centrally before placing the peripheral burn. This first burn will deepen the anterior chamber peripheral to it, allowing the more peripheral burn to be placed with less adverse consequences. In almost all patients, the endothelial burns disappear within several days and have not proved to be a major complication.

A transient rise in IOP can occur, as with other anterior segment laser procedures. Pigmented burn marks may develop at the sites of laser applications in some eyes. These do not generally have serious consequences.¹¹ Iris atrophy may rarely develop,¹¹ and this can be avoided by using the lowest laser power to achieve iris contraction, and also by leaving untreated spaces between 2 laser application sites.

Need for retreatment

The duration of the effect of the iridoplasty is variable. Long-term effectiveness is possible, but patients need to be followed closely for recurrence of the angle closure and, on occasion, patients may require retreatment.

Conclusion

ALPI is a safe and simple outpatient laser procedure that effectively opens up appositionally closed portions of the drainage angle. Since it does not eliminate pupillary block, laser peripheral iridotomy is still indicated if pupillary block is present.

ALPI is now a viable alternative first-line treatment for AAC, in place of systemic IOP-lowering medications. The procedure reduces IOP more rapidly than medications. Ongoing studies will tell whether ALPI can also reduce the rate of conversion to CAC after AAC.

References

1. Ritch R. Argon laser treatment for medically unresponsive attacks of angle closure glaucoma. *Am J Ophthalmol.* 1982; 94:197-204.
2. Ritch R. *Techniques of argon laser iridectomy and iridoplasty.* Palo Alto: Coherent Medical Press; 1983.
3. York K, Ritch R, Szmyd LJ. Argon laser peripheral iridoplasty: indications, techniques and results. *Invest Ophthalmol Vis Sci.* 1984;25(Suppl):94.
4. Ritch R, Solomon IS. Glaucoma surgery. In: L'Esperance FA, editor. *Ophthalmic lasers.* 3rd ed. St Louis: CV Mosby Co; 1989.
5. Ritch R. Argon laser peripheral iridoplasty: an overview. *J Glaucoma.* 1992;1:206-13.
6. Lim AS, Tan A, Chew P, et al. Laser iridoplasty in the treatment of severe acute angle-closure glaucoma. *Int Ophthalmol.* 1993;17:33-6.
7. Lam DS, Lai JS, Tham CC. Immediate argon laser peripheral iridoplasty as treatment for acute attack of primary angle-closure glaucoma: a preliminary study. *Ophthalmology.* 1998;105:2231-6.
8. Lai JS, Tham CC, Lam DS. Limited argon laser peripheral iridoplasty as immediate treatment for an acute attack of angle-closure glaucoma: a preliminary study. *Eye.* 1999;13:26-30.
9. Tham CC, Lai JS, Lam DS. Immediate argon laser peripheral iridoplasty for acute attack of primary angle-closure glaucoma. *Ophthalmology.* 1999;106:1042-3.
10. Lam DS, Lai JS, Tham CC, Chua JK, Poon AS. Argon laser peripheral iridoplasty versus conventional systemic medical therapy in treatment of acute primary angle-closure glaucoma: a prospective, randomized, controlled trial. *Ophthalmology.* 2002;109:1591-6.
11. Lai JS, Tham CC, Chua JK, Poon AS, Lam DS. Laser peripheral iridoplasty as initial treatment of acute attack of primary angle-closure: a long-term follow-up study. *J Glaucoma.* 2002;11:484-7.
12. Lam DS, Tham CC, Lai JS, Chua JK. Management of acute primary angle-closure – past, present, and future. *Asia Pacific J Ophthalmol.* 2001;13:6-10.
13. Lai JS, Tham CC, Chua JK, et al. To compare argon laser peripheral iridoplasty (ALPI) against systemic medications in treatment of acute primary angle-closure: mid-term results. *Eye.* 2006;20:309-14.

14. Chew PT, Yeo LM. Argon laser iridoplasty in chronic angle-closure glaucoma. *Int Ophthalmol*. 1995;19:67-70.
15. Rosman M, Aung T, Ang LP, Chew PT, Liebmann JM, Ritch R. Chronic angle-closure with glaucomatous damage: long-term clinical course in a North American population and comparison with an Asian population. *Ophthalmology*. 2002;109:2227-31.
16. Campbell DG, Vela A. Modern goniosynechialysis for the treatment of synechial angle-closure glaucoma. *Ophthalmology*. 1984;91:1052-60.
17. Shingleton BJ, Chang MA, Bellows AR, Thomas JV. Surgical goniosynechialysis for angle-closure glaucoma. *Ophthalmology*. 1990;97:551-6.
18. Lai JS, Tham CC, Chua JK, Lam DS. Efficacy and safety of inferior 180° goniosynechialysis followed by diode laser peripheral iridoplasty in the treatment of chronic angle-closure glaucoma. *J Glaucoma*. 2000;9:388-91.
19. Lai JS, Tham CC, Chua JK, Lam DS. Immediate diode laser peripheral iridoplasty as treatment of acute attack of primary angle-closure glaucoma: a preliminary study. *J Glaucoma*. 2001;10:89-94.
20. Teekhasaene C, Ritch R. Combined phacoemulsification and goniosynechialysis for uncontrolled chronic angle-closure glaucoma after acute angle-closure glaucoma. *Ophthalmology*. 1999;106:669-74.
21. Ritch R. Plateau iris is caused by abnormally positioned ciliary processes. *J Glaucoma*. 1992;1:23-6.
22. Peng D, Zhang X, Yu K. Argon laser peripheral iridoplasty and laser iridectomy for plateau iris glaucoma. *Zhonghua Yan Ke Za Zhi*. 1997;33:165-8.
23. Ritch R, Tham CC, Lam DS. Long term success of argon laser peripheral iridoplasty in the management of plateau iris syndrome. *Ophthalmology*. 2004;111:104-8.
24. Tham CC, Lai JS, Poon AS, et al. Immediate argon laser peripheral iridoplasty (ALPI) as initial treatment for acute phacomorphic angle-closure (phacomorphic glaucoma) before cataract extraction: a preliminary study. *Eye*. 2005;19:778-83.
25. Yip PP, Leung WY, Hon CY, Ho CK. Argon laser peripheral iridoplasty in the management of phacomorphic glaucoma. *Ophthalmic Surg Lasers Imaging*. 2005;36:286-91.
26. Metz D, Ackerman J, Kanarek I. Laser trabeculoplasty enhancement by argon laser iridotomy and/or iridoplasty. *Ophthalmic Surg*. 1984;15:535.