No prospective randomized study has shown that cataract surgery combined with ECP is more effective than cataract surgery alone. These procedures often need to be repeated because their IOP-lowering effect diminishes over time.

Aquino MC, Barton K, Tan AM, et al. Micropulse versus continuous wave transscleral diode cyclophotocoagulation in refractory glaucoma: a randomized exploratory study. *Clin Exp Ophthalmol*. 2015;43(1):40–46.

Laser Peripheral Iridotomy

In laser peripheral iridotomy (LPI), laser energy is used to create a hole in the peripheral iris, which provides an alternative pathway for aqueous to enter the anterior chamber, bypassing the channel between the lens and iris.

Mechanism of Action

As described in Chapter 9, primary angle closure (PAC) occurs as a result of a relative increase in resistance to aqueous flow through the pupil to the anterior chamber (ie, *pupillary block*) and increases pressure posterior to the iris, causing it to bow anteriorly against the TM. These events lead to narrowing of the anterior chamber angle. LPI provides an alternative pathway for aqueous to enter the anterior chamber (Fig 13-4), relieving the pupillary block; this allows the iris to fall back and subsequently widen the angle.

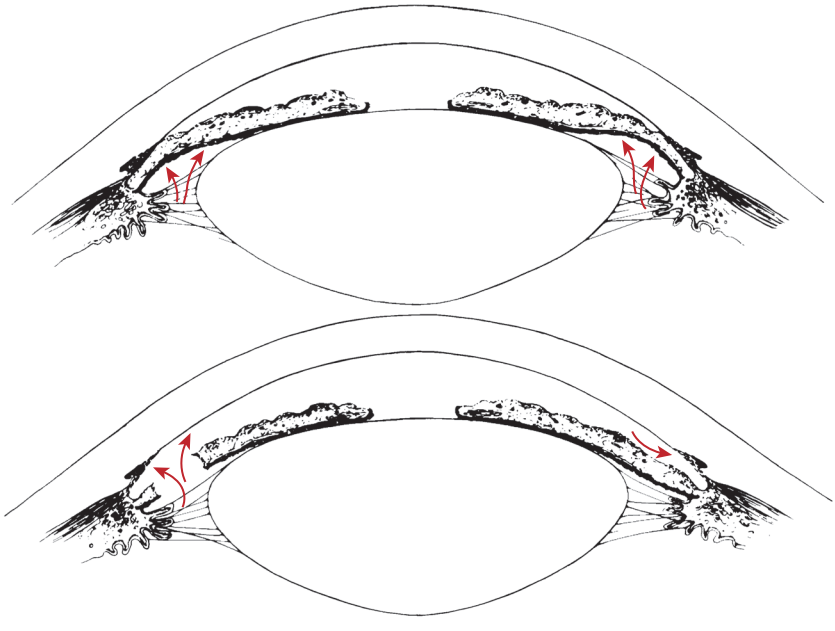

Figure 13-4 Illustration of an eye with angle closure *(top)*. Laser peripheral iridotomy or surgical iridectomy disrupts the pupillary block and results in opening of the entire peripheral angle *(bottom)* if no permanent peripheral anterior synechiae are present. *(Modified with permission from Kolker AE, Hetherington J, eds.* Becker-Shaffer's Diagnosis and Therapy of the Glaucomas. *5th ed. Mosby; 1983.)*

Indications and Contraindications

Laser peripheral iridotomy is performed when pupillary block is the suspected cause of iris–trabecular meshwork contact. Patients with acute primary angle closure (APAC), PAC, and primary angle-closure glaucoma (PACG) all benefit from iridotomy. In addition, LPI is often performed in PAC suspects, although it is unclear whether LPI is beneficial for these patients (see the section Efficacy for further discussion). Eyes with pupillary block–induced secondary angle closure also benefit from iridotomy. Multiple and/or larger iridotomies may be indicated for patients with substantial posterior synechiae.

In patients with a very shallow or flat peripheral anterior chamber, LPI can cause damage to the corneal endothelium. In patients who have angle closure without pupillary block (eg, neovascular glaucoma or iridocorneal endothelial syndrome), iridotomy is ineffective. Eyes with 360° of synechial angle closure (caused by chronic iridotrabecular contact) do not benefit from iridotomy.

Technique

Laser peripheral iridotomy requires a cooperative patient and an adequate view of the iris. To achieve these conditions in patients with APAC, medical IOP reduction is helpful because it reduces corneal edema and alleviates pain. Any form of ocular hypotensive medication can be used. IOP reduction can also be achieved via careful paracentesis.

When a prophylactic iridotomy is performed, a topical hypotensive agent is administered before the procedure to prevent postoperative IOP elevation. Pilocarpine may be instilled to constrict the pupil, which then stretches the iris and facilitates iris penetration by the laser. Pilocarpine may be ineffective in patients with ischemia of the iris sphincter muscle caused by prolonged APAC.

An iridotomy lens with a viscous coupling agent is used for visualization. The surgeon should evaluate the iris to determine iridotomy placement; the most peripheral location possible is preferred. A smaller amount of energy is required when the iridotomy is placed in an area of thinner iris (eg, an iris crypt). Nd:YAG or photothermal lasers (argon green or diode) can be used for iridotomy creation. For patients with thicker and darker irides, some surgeons suggest pretreatment with a photothermal laser to thin the iris, then using the Nd:YAG laser to penetrate the iris. Because pretreatment coagulates underlying blood vessels, it may also be beneficial for patients with a high risk of prolonged bleeding (ie, patients taking blood thinners). Laser settings vary widely according to surgeon preference and laser type. When the laser penetrates the iris, fluid and pigment are usually released into the anterior chamber. Although transillumination is useful for locating the iridotomy, it does not signify patency. The iridotomy should be of sufficient size. There is evidence that the creation of a larger iridotomy in eyes with small iridotomies can help to deepen the anterior chamber.

Postoperative Care

Intraocular pressure is checked 30 minutes to 1 hour after the procedure to monitor for potential acute pressure elevations. If necessary, steroids can be prescribed for approximately 1 week to treat postoperative inflammation associated with tissue disruption and bleeding. Topical hypotensive agents can also be used (when needed) for IOP control. The patient is

examined 1–6 weeks after LPI to confirm iridotomy patency, determine whether the angle has deepened on gonioscopic examination, and evaluate the fundus. If the angle remains narrow after iridotomy, further evaluation can be considered (see Chapter 9).

Complications

Complications of iridotomy include hyphema, persistent postoperative inflammation, accelerated cataract formation, pupil distortion, and lens damage. Retinal tears, postoperative acute IOP elevation, and corneal endothelial damage can also occur. Visual dysphotopsias (glare, streaks, lines, and/or halos) may be present; they are suspected to result from iridotomy proximity to the tear meniscus, which acts as a prism and bends incident light through the iridotomy. Thus, some surgeons suggest temporal placement of the iridotomy, with precautions to ensure it remains distant from the tear meniscus. However, there is mixed evidence concerning whether iridotomy location (superior or temporal) affects the likelihood of dysphotopsias.

Srinivasan K, Zebardast N, Krishnamurthy P, et al. Comparison of new visual disturbances after superior versus nasal/temporal laser peripheral iridotomy: a prospective randomized trial. *Ophthalmology*. 2018;125(3):345–351.

Vera V, Naqi A, Belovay GW, Varma DK, Ahmed II. Dysphotopsia after temporal versus superior laser peripheral iridotomy: a prospective randomized paired eye trial. *Am J Ophthalmol.* 2014;157(5):929–935.

Efficacy

Laser peripheral iridotomy is effective in deepening the angle in pupillary block–induced forms of angle closure. However, some patients exhibit persistent angle closure despite a patent iridotomy; this situation requires further evaluation. LPI can be useful for controlling IOP in patients with PAC; however, long-term medical or surgical treatment is required in approximately 40%–60% of patients with PAC who undergo LPI. Iridotomy is also useful in the immediate management of APAC. However, it is less effective than phacoemulsification for long-term IOP control. One study showed that approximately 50% of patients who underwent LPI for APAC had IOP elevation >21 mm Hg at 18 months, compared with 3% in the phacoemulsification group. Most PACG eyes require additional IOP treatment despite iridotomy. The rate of conversion from PAC to PACG despite iridotomy is low, but the rate of conversion from APAC to PACG despite iridotomy is high.

The Zhongshan Angle-Closure Prevention (ZAP) trial prospectively enrolled 889 patients with suspected PAC. For each patient, management comprised LPI treatment in one eye and observation in the other eye. At 6 years, angle-closure disease was more likely to develop in control eyes (36 eyes vs 19 eyes; $P = .004$), most commonly on the basis of PAS formation. However, both groups had a very low rate of conversion overall, and there were no significant differences in acute angle-closure events or IOP elevation >24 mm Hg (see Chapter 9, Treatment Controversies sidebar).

Table 13-1 summarizes the main points of the preceding subsections on LPI.

Table 13-1 Iris Laser Procedures: Key Points

Laser Peripheral Iridotomy	Laser Iridoplasty
Patients with APAC, PAC, and PACG may benefit from LPI. In patients who have either angle closure without pupillary block or 360° of synechial angle closure, LPI is ineffective. Photothermal laser pretreatment may be beneficial for patients with a high risk of bleeding or with thick irises. There is mixed evidence concerning whether iridotomy location affects the likelihood of dysphotopsias. The rate of conversion from PAC to PACG despite iridotomy is low, but the rate of conversion from APAC to PACG despite iridotomy is high.	Laser parameters differ from those for LPI in that energy is lower, spot size is larger, and duration is longer. For patients with APAC who are not candidates for iridotomy, laser iridoplasty has efficacy similar to medical management in terms of short-term IOP reduction. The effectiveness of laser iridoplasty in preventing PAC or PACG is unclear.

APAC = acute primary angle closure; IOP = intraocular pressure; LPI = laser peripheral iridotomy; PAC = primary angle closure; PACG = primary angle closure-glaucoma.

He M, Jiang Y, Huang S, et al. Laser peripheral iridotomy for the prevention of angle closure: a single-centre, randomised controlled trial. *Lancet.* 2019;393(10181):1609–1618.

Radhakrishnan S, Chen PP, Junk AK, Nouri-Mahdavi K, Chen TC. Laser peripheral iridotomy in primary angle closure: a report by the American Academy of Ophthalmology. *Ophthalmology*. 2018;125(7):1110–1120.

Laser Iridoplasty

Mechanism of Action

Laser iridoplasty (also called *laser peripheral iridoplasty* or *gonioplasty*) is performed by using a thermal laser (argon green or diode) to treat the peripheral iris stroma. This treatment causes contraction of collagen fibers and thinning of the peripheral iris, pulling it away from the angle recess. For a summary of the main points made in the following subsections on laser iridoplasty, see Table 13-1.

Indications and Contraindications

Laser iridoplasty is performed to prevent the development of PAC and PACG in eyes that have narrow angles despite a patent peripheral iridotomy. Occasionally, iridoplasty is used to disrupt episodes of acute angle closure in eyes with an anterior chamber too shallow to allow iridotomy. Although there is controversy and minimal evidence, laser iridoplasty may be beneficial in patients with plateau iris syndrome, phacomorphic angle closure, or nanophthalmos if iridotomy cannot adequately open the angle.