Trans-Scleral Diode Cyclophotocoagulation

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Various cyclodestructive procedures like surgical excision of ciliary body, cyclodiathermy, cycloirradiation, cycloelectrolysis, cyclocryotherapy, ultrasound, microwave cyclodestruction, and cyclophotocoagulation have traditionally been the last resort of eye surgeons for refractory glaucomas. Of these, laser cyclophotocoagulation, both transcleral diode cyclophotocoagulation, DLCP, and endoscopic cyclophotocoagulation, ECP, cause a targeted destruction of the melanin in the ciliary epithelium and consequently, less pain and inflammation (Figure 1), and are therefore preferred. Modern cycloablation can broadly be classified into the following[1,2]:

1. Contact (transcleral) cycloablation
   Cyclocryotherapy
   - Diode
   - Nd:YAG
2. Noncontact cycloablation
   - Nd:YAG
   - Diode
3. Transpupillary argon green cyclophotocoagulation
4. Endolaser ablation
   - Diode
   - (Reproduced from ISGS Textbook of Glaucoma Surgery, first edition, 2014, Jaypee Brothers Medical Publishers)
   - This article will concentrate on transcleral DLCP, the most commonly used method of cycloablation.

MECHANISM OF ACTION

The mechanisms of the IOP lowering action of DLCP[1-5] include:

1. DLCP targets and destroys the melanin-containing pigmented ciliary epithelium resulting in decreased aqueous production (Figure 1).
2. Destruction of ciliary blood vessels results in ischemia, and results in coagulative necrosis.
3. The induced inflammation also contributes to the decrease in IOP in the immediate postoperative period.
4. There may also be an increase in uveoscleral outflow and the creation of a trans-scleral flow as in a cyclodialysis, which may contribute to further IOP lowering.

INDICATIONS[1-34]

1. Primary glaucomas refractory to conventional glaucoma therapy, including surgeries.
2. Pain relief in a glaucomatous blind eye/ eye with poor visual potential.
3. Uncontrolled high IOPs in eyes with poor visual potential.
4. Neovascular glaucoma.

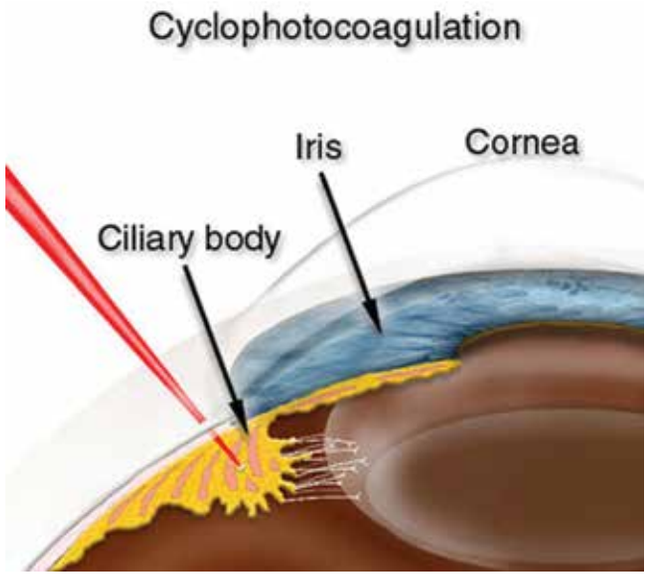

Figure 1: *Mechanism of action of DLCP, destruction of ciliary epithelium.*

5. Secondary glaucomas including post traumatic glaucoma, Post penetrating keratoplasty glaucoma, Post VR surgery glaucomaand uveiticglaucoma.
6. Failed trabeculectomy.
7. Failed drainage implants.
8. Congenital glaucoma with multiple failed surgeries.
9. In patients not fit for incisional surgery.
10. Patients refusing conventional glaucoma surgery.

CONTRA-INDICATIONS

The following conditions require extra careand careful titration of the energy settings, and are not really contraindications:

- Post keratoplasty glaucomas.
- Post glaucoma drainage devices.
- Excessively thinned sclera/ patients with collagen vascular disease.
- Pigmented conjunctiva, nevus.

SURGICAL STEPS

Step 1: Preoperative work up

A written, comprehensive, informed consent, detailing the risks, benefits and alternatives of the procedure is essential before the patient is taken up for DLCP. Also, the patients complete preoperative work-up, including details of vision, eye pressure, visual field and optic nerve head status must be recorded before planning surgery.

The patient must be explained the possibility of postoperative pain and decrease of vision. In addition, the patient must understand that more than one transscleral CPC treatment session may be required to achieve adequate IOP control, despite continued glaucoma medications.

Step 2: Anesthesia

The procedure is performed under peribulbar anaesthesia, under full aseptic precautions.

Step 3: Performing DLCP

A. Probe placement

- The semi-conductor solid state diode laser system (OculightSLx, Iridex Corporation, Mountain View, CA) which has a wavelength of 810 nm is used to perform transscleralcyclophotocoagulation (Figure 2).
- The hand piece (Iridex, Mountain View, CA) is placed 2 mm posterior to the limbus in the region of the ciliary body. The G probe is preferred for delivery of the laser. If using the G probe, the probe is placed with its edge at the limbus (Figure 3). The laser delivery is thus automatically centred 1.2 mm posterior to the limbus (Figure 4).
- The fiber optic transmission system protrudes 0.7 mm from the footplateand indents the conjunctiva and sclera (Figure 5). The pressure effect of the indentation helps to empty out the para limbal conjunctival vessels, therefore optimizing the laser transmission to the ciliary body.
- Contiguous spots are applied using the G probe.Care should be taken that thetrailing edge of the footplate bisects the temporary indentation on the conjunctiva at the site of the previous application. This ensures that the laser application is contiguous. If not using the G-probe is not used, make sure that each subsequent application is equidistant, and at a space of one-half the width of the footplate.

B. Settings

- To begin with, the power setting is kept at 1500 mW for 2 seconds. Most surgeons prefer to put 17-21 spots over 270 degree (sparing 3 and 9 o'clock) 7 spots per quadrant.
- Some surgeons advocate leaving the superonasal quadrant for future surgeries, and also may prevent possible anterior segment necrosis.
- The power used is then individualized and titrated on a case to case basis, depending on the tissue response. In case a "pop" sound is heard, it signifies a tissue explosion within the ciliary body or the iris root.The power is thendecreased in 100mW increments till the classic popsound is not heard. In case no pop is heard, power is increased in 100mW increments till the pop is heard, and then decreased to 100mW below that power setting. The maximum power that may be used is 2250 mW.
- The variability in the clinical response to DLCP may be due to variability in the pressure exerted over the sclera, differences in scleral thickness and variation in probe inclination.

TIPS AND TRICKS

- For pigmented eyes, use lower power settings for a longer treatment duration.For example, for a dark iris, start with settings of 1.25 W, for a 4.0second duration, titrating the energy depending on the popsound. On the other hand, for lightly pigmented eyes, a power setting of 1.5 W, with a 2.0second duration is recommended. Either case requires the titration of energy to just below the pop sound, as explained earlier.1-5, 18,20
- Avoid the 3:00 and 9:00 o'clock positions, in order to decrease pain. These are the positions of the ciliary nerves.
- Avoid areas of increased conjunctival pigmentation to avoid surface burns15.
- Try and keep the cumulative energy used to a minimum, in order to minimise postoperative inflammation.
- In case you are reusing the probe, make sure it is cleaned meticulously. Clean the debris that accumulates at the tip of the probe before reuse, since the charring of this debris is the most common cause for scleral and conjunctival burns.

POSTOPERATIVE MANAGEMENT

- At the end of the procedure, the eye is bandaged for 6-8 hours, preferably overnight.
- Make sure you prescribe adequate oral analgesic and anti-inflammatory medication.
- Continue the previous anti-glaucoma medications, these may be withdrawn gradually as the effect of the cyclophotocoagulation sets in.
- Prescribe additional oral anti-glaucoma medication in the immediate postoperative period to deal with postoperative IOP spikes.
- Prescribe topical steroids (Prednisolone Acetate eyedrops 1%) at least four times a day, for at least a week, and then taper over two weeks.
- The use of topical cycloplegics (Atropine 1% eyedrops, three times

Figure 2: *Semiconductor solid state diode laser system (Oculight SLx, Iridex Corporation, Mountain View, CA).*

Figure 3: *Foot plate of G-probe with its anterior curved edge at the limbus.*

Figure 4: *Foot plate of IRIS G-probe showing laser delivery point, situated 1.2mm posterior to the anterior edge.*

Figure 5: *Side view of IRIS G-probe showing protruding fibre optic (0.7mm) from foot plate.*

Table 1: Treatment parameters for Noncontact versus Contact TS-DLCP

(Reproduced from Manual of Glaucoma, first edition, 2016, Jaypee Brothers Medical Publishers)

Parameter	Non Contact TS-DLCP	Contact TS-DLCP
Energy	1.2 mWwatts (To be titrated as per "pop")	1.25-1.5 mW (To be titrated as per "pop")
Duration	990 milliseconds	2.0-4.0 seconds
Spots	40	24-30
Circumference treated (in degrees)	360	270-360

a day) help in managing the post-operative pain, and is an individual choice.

COMPLICATIONS

The therapeutic window of all cycloablative procedures is narrow, and it is important to keep a look out for these complications after DLCP. This list of complications is by no means exhaustive, but these possible complicatons must be discussed with the patient while taking the informed consent.

- Surface burns, ranging from superficial conjunctival burns (common) to scleral perforations with uveal prolapse (rare)[15]
- Postoperative inflammation ranging from mild inflammation to severe uveitis and associated pain and photphobia
- Atonic pupil
- Decrease or loss of vision
- Hyphema and vitreous haemorrhage, especially in eyes with NVG.
- Hypotony, ranging from mild hypotony to phthisis bulbi, especially in eyes following GDD
- Cataract
- Scleral thinning and staphyloma
- Corneal decompensation
- Malignant glaucoma[33]
- Sympathetic Ophthalmia[34]

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