Efficacy of Transscleral Diode Laser Cyclophotocoagulation for Refractory Glaucomas in a South Indian Population

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Aim: *To investigate the efficacy and safety of contact transscleral diode laser cyclophotocoagulation for refractory glaucomas in a South Indian population.*
Patients and Methods: *106 eyes of 97 patients with refractory glaucoma and uncontrolled ocular pressures on maximum tolerated medical treatment with high risk of failure of glaucoma filtering surgery received contact transscleral diode cyclophotocoagulation and were retrospectively analysed for safety and efficacy of the procedure. The aetiologies were categorised as congenital (n = 30; 28.3%), rubeotic (28; 26.4%), post-traumatic (13; 12.3%), chronic angle closure glaucoma (6; 5.7%), post-penetrating keratoplasty (3; 2.8%) and others (21; 19.8%).*
Results: *Mean intraocular pressure decreased significantly from 39.6 ± 9.9 to 22.6 ± 0.9, a 59% reduction (p = 0.000) after 3 to 18 months of follow-up. Significant intraocular pressure reduction (p = 0.000) was seen in all groups except post-vitreoretinal surgery eyes. Success defined as intraocular pressure <22 mm Hg occurred in 75 eyes (70.8%) with a single treatment and in 31 eyes (29.2%) with multiple treatments (mean no. of treatments, 1.6). Overall, the technique had a response rate of 44.3% and a success rate of 39.6%; the retreatment rate was 29%. Hypotony was the most frequent adverse event (4.7%).*
Conclusion: *Contact transscleral diode cyclophotocoagulation effectively lowers intraocular pressure in eyes with refractory glaucomas with high risk of failure with glaucoma filtering surgery with few side effects in our population.*

Key words: *Filtering surgery, Glaucoma, Laser coagulation, Reoperation, Treatment outcome*

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Introduction

Transscleral diode laser cyclophotocoagulation (cyclodiode) has been established as a relatively safe and effective intervention for glaucoma resistant to conventional management.[1,2] The procedure has become increasingly popular in recent years as an alternative to the surgical options for refractory glaucoma, such as anti-metabolite augmented trabeculectomy and tube shunt surgery. It has been shown to be safer than other cyclophotocoagulation and cyclocryotherapy methods, which present a significant risk of hypotony and phthisis because of excessive ciliary body ablation.[3-5] However,[6,7] the outcome of cyclodiode therapy is unpredictable and multiple treatments may be required to achieve the desired result. Furthermore, no consensus exists for an optimum treatment protocol.

The main objectives of this study were to: (a) evaluate the relation between total diode laser energy delivered and the change in intraocular pressure (IOP); and (b) identify possible predictive factors that could help establish optimum treatment parameters. Secondary goals were to: (a) study the efficacy and safety of diode laser cyclophotocoagulation; and (b) evaluate the IOP-lowering effect following each treatment session in patients receiving multiple treatments, to help with management planning and patient counseling.

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Patients and Methods

A retrospective analysis of 97 patients who had undergone cyclodiode therapy in Aravind Eye Hospital, Madurai over a period of 1 year was peformed. Data were collected pertaining to patient

Table 1. Intraocular pressure (IOP)-lowering effect and dose of cyclodiode laser according to diagnostic category.

Diagnostic category	No. of eyes (%)	No. of treatments [mean (SD)]	Mean pre-laser IOP (mm Hg) [mean (SD)]	Post-laser IOP (mm Hg) [mean (SD)]	Percentage change in IOP [mean (SD)]
All eyes	106 (100)	1.6 (0.9)	39.6 (9.9)	22.6 (9.1)	58.6 (23.7)
Rubeotic	28 (26.4)	1.2 (0.6)	37.6 (8.3)	23.6 (9.3)	64.6 (24.5)
Post-penetating keratoplasy	3 (2.8)	1.0 (0)	38.7 (10.1)	16.7 (12.6)	39.3 (22.4)
Post-vitreoretinal surgery	5 (4.7)	1.2 (0.4)	38.2 (10.6)	26.4 (15.3)	73.9 (50.2)
Chronic angle closure glaucoma	6 (5.7)	1.2 (90.4)	46.0 (11.9)	24.7 (9.5)	58.1 (34.5)
Post-traumatic	13 (12.3)	1.4 (0.8)	38.9 (11.1)	19.7 (8.5)	52.0 (22.7)
Congenital	30 (28.3)	2.2 (1.3	38.5 (9.1)	23.0 (6.5)	60.8 (15.3)
Others	21 (19.8)	1.4 (0.9)	43.0 (11.0)	21.9 (10.2)	50.7 (19.2)

demographics, glaucoma diagnosis and cyclodiode laser delivery. The following data were recorded before and after cyclodiode therapy: IOP, antiglaucoma medications, visual acuity and complications.

Transscleral diode laser photocoagulation was performed using Oculight SLx 810 mm medical diode laser and G-probe (IRIS Medical Instruments Inc., Mountainview, CA, USA). Treatments were administered under local anesthesia (2% lignocaine). The G-probe was placed approximately 1.2 mm to 1.5 mm posterior to limbus with an axial orientation.

The treatment parameters were: energy, 1500-2000 mW; duration, 1500 ms; site, 180°-270° of ciliary body excluding the superonasal quadrants with sparing of 3 and 9 o'clock; no. of burns, 20-24. Postoperatively, the treated eye was patched for 1 to 6 hours and topical steroid drops were applied 4 times a day and tapered as inflammation subsided. Antiglaucoma medications were reduced and discontinued according to the IOP response. The IOP at final follow-up (12 months) was used to evaluate the relation between the total diode laser energy and the drop in IOP. The outcome[8] of cyclodiode therapy was defined in terms of success rate, response rate, complication rate and cyclodiode efficacy index. The success rate was defined as the percentage of eyes achieving an IOP between 5 mm Hg and 21 mm Hg or a greater than 30% drop in IOP following cyclodiode therapy at the final follow-up visit. The response rate was defined as the percentage of patients achieving an IOP of less than 22 mm Hg or a greater than 30% drop in IOP including hypotonous eyes IOP <5 mm Hg. The cyclodiode efficacy index measured the sensitivity of IOP to cyclodiode therapy and was defined as the ratio of response rate to mean number of treatment sessions.

Results

A total of 106 eyes of 97 patients (68 males [64.2%] and 38 females [35.8%]) were followed up for 12 months. The mean age of patients was 37 ± 27 years. The diagnostic categories comprised the rubeotic group (28 patients; 26.4%), congenital (30 patients; 28.5%), others (21 patients; 19.8%), post-traumatic (13 patients; 12.3%), chronic angle closure glaucoma (CACG) [6 patients; 5.7%], post-vitreoretinal (VR) surgery (5 patients; 4.7%) and post-penetrating keratoplasty (PKP) [3 patients; 2.8%]. Data relating to number of cyclodiode treatment sessions, effect on IOP and amount of laser energy applied for each diagnostic category are shown in Table 1.

Table 2. Repeat treatments according to age.*

Age	Repeat treatment		Total
	Yes	No	
<40 years			
n (% of age group)	26 (46.4)	30 (53.6)	56 (100)
Percent of treatment group	83.9	40	52.8
≥40 years			
n (% of age group)	5 (10)	45 (90)	50 (100)
Percent of treatment group	16.1	60	47.2
Total			
n (% of age group)	31 (29.2)	75 (70.8)	106 (100)
Percent of treatment group	100	100	100

* Effect of age on retreatment: p = 0.000.

The distribution of eyes by number of treatment sessions and age-related repeat treatments are shown in Table 2. Retreatment was more common in the age group less than 40 years. The mean number of retreatments was highest in the congenital group (2.2), whereas it was lowest in the post-PKP group (1.0).

The outcome of cyclodiode therapy for each diagnostic category is shown in Table 3. Mean values for IOP before (39.6 ± 9.9 mm Hg) and after (22.6 ± 9.1 mm Hg) laser treatment revealed a significant (p = 0.000) 59% reduction in this variable. Figure 1 shows the scatter plot of IOP readings after cyclodiode treatment in the study group. Of all categories, the best outcome occurred in post-PKP eyes, which had the highest success rate (66.7%), the lowest retreatment rate and the lowest hypotony rate. Satisfactory outcome was seen in eyes in the diagnostic categories of POAG, others, post-traumatic, chronic angle closure and post-VR surgery. The lowest success rate was seen in rubeotic eyes (25%). Retreatment rate was highest in the congenital glaucoma group (60%), which also had the lowest value for cyclodiode efficacy index (0.19) [Table 3].

Table 3. Clinical outcome of cyclodiode therapy according to diagnostic category.

Diagnostic category	No. of eyes (%)	Response rate (%)	Success rate (%)	Retreatment rate (%)	Hypotony rate (%)	Cyclodiode efficacy index*
All eyes	106 (100)	44.3	39.6	29.2	4.7	0.28
Rubeotic	28 (26.4)	32.1	25.0	14.3	7.1	0.27
Post-penetrating keratoplasty	3 (2.8)	66.7	66.7	0	0	0.67
Post-vitreoretinal surgery	5 (4.7)	60.0	60.0	20.0	0	0.50
Chronic angle closure glaucoma	6 (5.7)	33.3	33.3	16.7	0	0.27
Post-traumatic	13 (12.3)	61.5	53.8	23.1	7.7	0.44
Congenital	30 (28.3)	43.3	43.3	60.0	0	0.19
Others	21 (19.8)	47.6	38.1	19.0	9.5	0.34

* Defined as the ratio of response rate to mean number of treatment sessions.

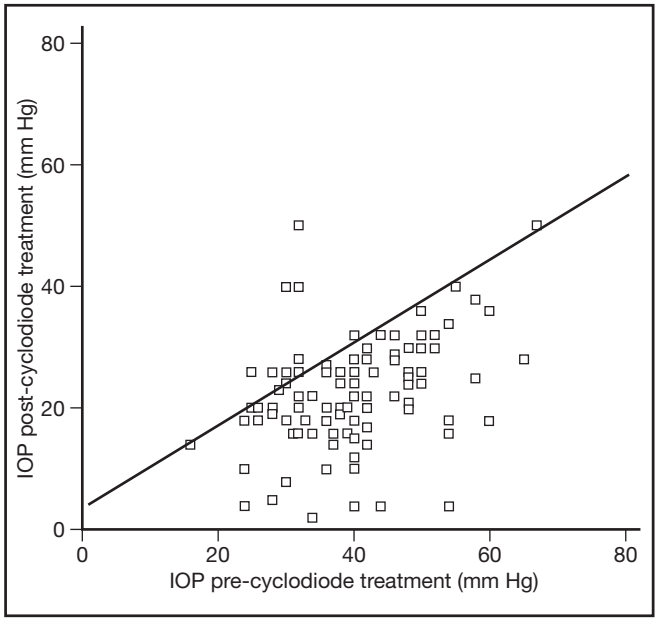
Hypotony (IOP <5 mm Hg) occurred in 4.7% of eyes overall and had an incidence of 7.1%, 7.7%, and 9.55% in the rubeotic, post-traumatic and others category, respectively. No complications occurred in the remaining categories.

Discussion

Cyclodiode coagulation has been used effectively to manage long-standing and severe refractory glaucomas.[9-11] It lowers IOP by decreasing aqueous production regardless of trabecular function and so theoretically should work in CACG eyes even with long-standing glaucomas. The reported success rates in refractory glaucomas ranged from 34% to 87%.[2,4,6,7,9-11]

The results of the present study confirm the findings of other investigators that transscleral cyclodiode therapy is highly effective in lowering IOP. Response rates above 60% were seen for post-PKP and post-VR surgery and post-traumatic eyes. Poor response rates were seen for rubeotic (32.1%) and congenital (43.3%) aetiologies, indicating that they were relatively refractory to treatment. A comparatively poor response rate of 75% for congenital glaucoma, as previously reported, confirmed that this form is relatively refractory to treatment and requires multiple treatments.[12] Lower age has been found to adversely effect the success of cycloablative procedures.[13]

Figure 1. Scatter plot of intraocular pressure (IOP) values before and after cyclodiode treatment.



The results for cyclodiode efficacy index indicated that the sensitivity to treatment was highest in the post-PKP group (0.67) and lowest in the congenital group (0.19). The retreatment rate, which also reflected the sensitivity to cyclophotocoagulation, was highest in the congenital group (60%) and least in the post-PKP group (0.0%).

The most common adverse effects of cyclodiode therapy are hypotony and phthisis. Bloom and coworkers reported a hypotony rate of only 1%, comprising only 12% of eyes with neovascular glaucoma.[7] In a recent study in which neovasular glaucoma accounted for 60% of the patients, the incidence of hypotony was 18%.[14] Spencer and Vernon reported a low (3.4%) incidence of hypotony in a series of 58 eyes of which only 6 had neovascular glaucoma.[15] In our study, hypotony occurred in 4.7% of eyes overall, and 7.1% of rubeotic eyes.

While standard protocols have been evaluated, there is a lack of substantiating randomised trials comparing outcomes of different protocols.[15] In a series which comprised a variety of glaucoma aetiologies, a linear dose-response relationship that would help predict the outcome of cyclodiode therapy could not be obtained.[7,16] A similar study using fixed parameters and repeated cyclodiode treatment when necessary, reported that it appeared safe and effective in lowering IOP.[15] On the other hand, high pre-treatment IOP may cause ciliary body ischaemia which in turn may cause ciliary body shutdown following cyclophotocoagulation. A prudent approach is to keep the initial delivery of diode laser energy at a low level and to give successive multiple treatments at 6 to 8 weeks, thus minimising the risk of hypotony.

In summary, the present study has demonstrated that diode laser photocoagulation is an effective treatment for refractory glaucoma of all aetiologies. However, the optimum treatment

parameters for cyclodiode therapy remain unclear and a prospective trial may be required to establish a safe and predictable treatment protocol.

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