

# Efficacy and Safety of Transscleral Diode Laser Cyclophotocoagulation in Refractory Glaucoma: A Retrospective Case Series

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## Abstract

## Original Research Article

**Purpose:** To evaluate the efficacy and safety of transscleral diode laser cyclophotocoagulation in the management of refractory glaucoma. **Methods:** This retrospective case series included 15 eyes from 15 patients with refractory glaucoma treated between January 2024 and March 2025 at the Ophthalmology Department of the Avicenna Military Hospital of Marrakech. The primary outcome was intraocular pressure (IOP) reduction, while secondary outcomes included changes in the number of antiglaucoma medications and postoperative complications. Treatment success was defined as an IOP  $\leq 20$  mmHg without intensification of medical therapy. **Results:** The mean preoperative IOP was  $32.5 \pm 5.7$  mmHg. Following treatment, mean IOP decreased to  $25.2 \pm 7.5$  mmHg at day 1,  $20.9 \pm 5.0$  mmHg at day 7, and  $22.6 \pm 7.3$  mmHg at day 30. At 6 weeks, mean IOP reached  $16.6 \pm 5.1$  mmHg, corresponding to a 56.5% reduction from baseline ( $p < 0.001$ ). The mean number of antiglaucoma medications decreased from  $3.2 \pm 1.3$  preoperatively to  $1.6 \pm 0.9$  at 6 weeks, representing a 51.1% reduction ( $p < 0.001$ ). At 3 months, 12 patients were available for follow-up, of whom 10 maintained satisfactory IOP control with 1–2 medications, while one patient required repeat treatment. **Conclusion:** Transscleral diode laser cyclophotocoagulation appears to be an effective and relatively safe option for the management of refractory glaucoma, providing significant IOP reduction and decreasing treatment burden. Further studies with larger cohorts and longer follow-up are warranted to confirm these findings.

**Keywords:** Refractory glaucoma, Cyclophotocoagulation, Transscleral diode laser, Glaucoma treatment.

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## INTRODUCTION

Glaucoma is a progressive optic neuropathy characterized by the degeneration of retinal ganglion cells, leading to structural damage of the optic nerve head and irreversible visual field loss. It is the second leading cause of blindness worldwide and the leading cause of irreversible blindness, affecting more than 76 million people globally, with a projected increase to over 110 million by 2040 [1,2].

Refractory glaucoma encompasses a heterogeneous group of glaucomas that remain uncontrolled despite maximal medical therapy and/or conventional filtering surgery. Although no standardized definition exists, these cases are typically associated with complex mechanisms and poor therapeutic response. Any form of glaucoma may become refractory depending on its etiology and disease severity.

The management of refractory glaucoma remains challenging. Conventional surgeries often fail

due to conjunctival fibrosis and altered ocular anatomy, while medical therapy alone is frequently insufficient to achieve adequate intraocular pressure (IOP) control. Current therapeutic strategies aim either to enhance aqueous humor outflow using drainage devices or to reduce aqueous production through cyclodestructive procedures.

Transscleral cyclophotocoagulation (TSCPC) with diode laser is widely used in this context. It lowers IOP by targeting the ciliary processes and reducing aqueous humor secretion. However, conventional continuous-wave TSCPC has been associated with significant complications due to collateral tissue damage [3]. Newer approaches, such as micropulse or controlled cyclo-modulation techniques, aim to improve safety while maintaining efficacy [3,4].

The present study aims to evaluate the efficacy and safety of transscleral diode laser cyclophotocoagulation in the management of refractory

glaucoma, based on a retrospective analysis conducted at the Ophthalmology Department of the Avicenne Military Hospital of Marrakech.

## MATERIALS AND METHODS

This retrospective study aimed to evaluate the efficacy and safety of transscleral diode laser cyclophotocoagulation in patients with refractory glaucoma. The study adhered to the tenets of the Declaration of Helsinki and was approved by the local ethics committee. The primary outcome was intraocular pressure (IOP) reduction, while secondary outcomes included the decrease in antiglaucoma medications and the occurrence of complications. Treatment success was defined as an IOP  $\leq 20$  mmHg without intensification of preoperative therapy.

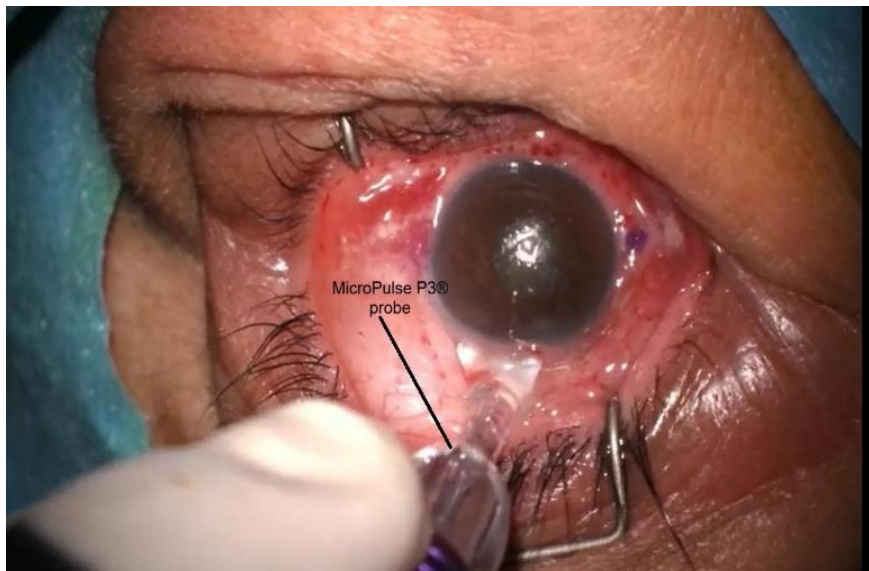
We included 15 eyes from 15 patients with refractory glaucoma treated between January 2024 and March 2025 at the Ophthalmology Department of the Avicenne Military Hospital of Marrakech. Patients were eligible if they were older than 18 years and had uncontrolled glaucoma despite maximal medical therapy, with no indication for further surgery or refusal of surgical intervention. Patients under 18 years of age, those with ocular surface disease, or with visual acuity greater than 5/10 were excluded.

Baseline data included demographic characteristics, medical and ophthalmological history, glaucoma type and duration, prior treatments, and a complete ocular examination with visual acuity, intraocular pressure, and fundus evaluation. None of the patients had previously undergone cyclodestructive procedures.

All procedures were performed under peribulbar anesthesia in the operating room using a diode laser system (IRIDEX Cyclo G6®) with a MicroPulse P3® probe. After sterile preparation, laser treatment was delivered at a wavelength of 810 nm with a power of 2000 mW. The probe was applied 1.5 mm posterior to the limbus and moved in a continuous sweeping motion over 360°, avoiding the 3 and 9 o'clock positions to prevent neurovascular damage.

Postoperatively, patients received topical corticosteroids and nonsteroidal anti-inflammatory drugs for four weeks. Antiglaucoma medications were gradually reduced according to IOP response, with discontinuation of oral acetazolamide when IOP fell below 20 mmHg. Follow-up included assessment of visual acuity, IOP at day 1, day 7, and day 30, as well as monitoring for complications.

Statistical analysis was performed using a paired t-test to compare preoperative and postoperative values, with a significance level set at  $p < 0.05$ .

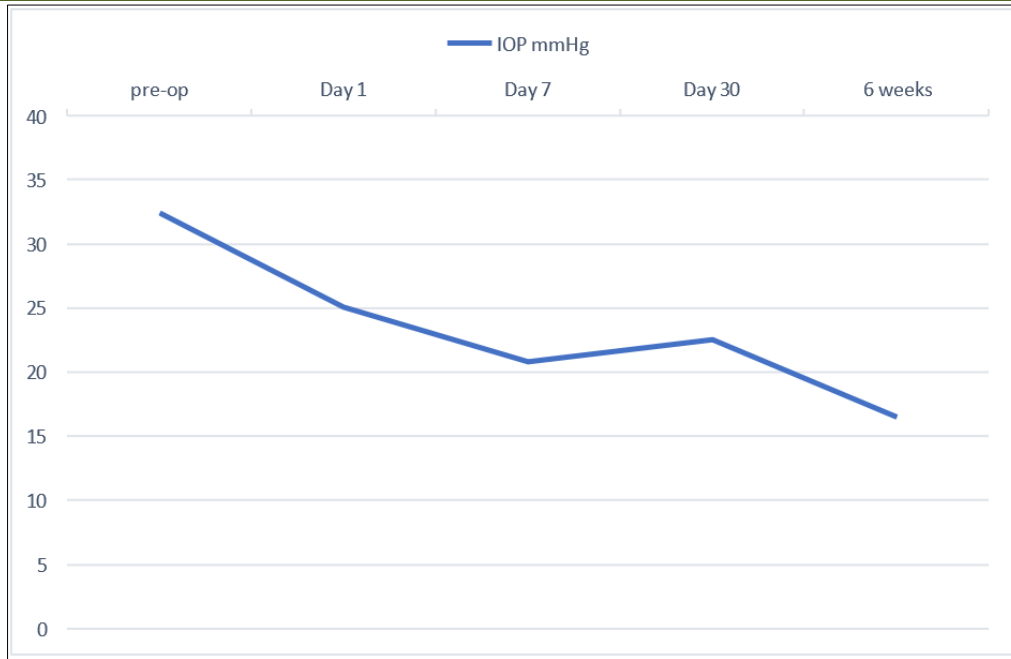


## RESULTS

Fifteen eyes from 15 patients were included in this study. The cohort comprised 10 men (66%) and 5 women (33%), with a mean age of  $63.4 \pm 6.4$  years (range: 52–77 years).

The mean preoperative intraocular pressure (IOP) was  $32.5 \pm 5.7$  mmHg. Following transscleral diode laser

cyclophotocoagulation, a decrease in IOP was observed from the first postoperative day and persisted throughout follow-up. Mean IOP was  $25.2 \pm 7.5$  mmHg at day 1,  $20.9 \pm 5.0$  mmHg at day 7, and  $22.6 \pm 7.3$  mmHg at day 30. At 6 weeks, mean IOP further decreased to  $16.6 \pm 5.1$  mmHg, representing an overall reduction of 56.5% compared with baseline (figure 1).

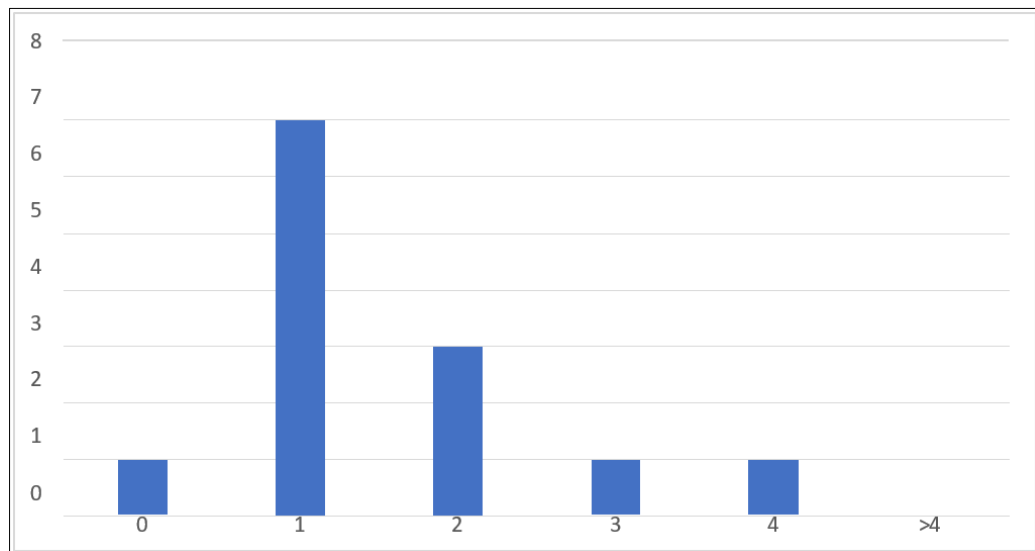


**Figure 1: Evolution of intraocular pressure (IOP) following transscleral diode laser cyclophotocoagulation.**

All patients were receiving antiglaucoma medications preoperatively, with a mean of  $3.2 \pm 1.3$  agents. At 6 weeks, most patients (90%) were maintained on a reduced regimen, with a mean of  $1.6 \pm 0.9$  medications, corresponding to a 51.1% reduction.

The reduction in both IOP and the number of medications was statistically significant when compared with preoperative values ( $p < 0.001$ ).

At 3 months, 12 patients were available for follow-up. Among them, 11 maintained satisfactory IOP control with 1 to 2 topical agents, while one patient required repeat cyclophotocoagulation and was subsequently managed with three medications (figure 2).



**Figure 2: Distribution of the number of antiglaucoma medications used by patients postoperatively.**

## DISCUSSION

In the present study, transscleral diode laser cyclophotocoagulation resulted in a marked and sustained reduction in intraocular pressure (IOP), with a mean decrease of 56.5% at 6 weeks. This level of reduction is consistent with previously reported

outcomes, where IOP reduction typically ranges from 30% to 60% depending on the population and treatment parameters [5,6].

The early reduction in IOP, observed from the first postoperative day and maintained over time, reflects

the rapid effect of ciliary body photocoagulation on aqueous humor production. Similar findings have been described in several clinical series evaluating diode laser cyclophotocoagulation [7]. The slight increase in IOP observed at one month in our study may be related to postoperative inflammatory response or partial recovery of ciliary body function, a phenomenon also reported in the literature [8].

A significant reduction in the number of antiglaucoma medications was also observed, with a decrease of more than 50% at 6 weeks. This finding is clinically relevant, as patients with refractory glaucoma are often exposed to multiple medications with limited tolerance. Comparable reductions in medication burden have been reported in recent studies, confirming the role of cyclophotocoagulation in simplifying therapeutic management [9].

At 3 months, most patients maintained satisfactory IOP control with a limited number of medications. However, one patient required retreatment, which is in line with previously reported data indicating that repeated procedures may be necessary in a subset of patients due to variable individual response [10].

Historically, cyclophotocoagulation was associated with significant complications, particularly with continuous-wave techniques. However, advances in laser delivery have improved the safety profile of the procedure, allowing a more controlled and targeted effect on the ciliary body [4]. Although our study was not designed to assess long-term safety, the absence of major complications in the early postoperative period is reassuring.

Several limitations should be acknowledged. The retrospective design, the relatively small sample size, and the short follow-up period limit the strength of our conclusions. In addition, long-term outcomes remain uncertain, as late IOP fluctuations have been described [8].

Despite these limitations, our results support the role of transscleral diode laser cyclophotocoagulation as an effective and relatively safe option in the management of refractory glaucoma, particularly in cases where conventional surgical options are limited.

## CONCLUSION

Transscleral diode laser cyclophotocoagulation appears to be an effective option for the management of refractory glaucoma, providing significant intraocular pressure reduction along with a meaningful decrease in antiglaucoma medication burden. In our series, the procedure achieved rapid and sustained IOP control with a favorable short-term safety profile.

These findings support its use as a valuable therapeutic alternative, particularly in patients with limited surgical options or poor tolerance to medical therapy. However, given the retrospective design and limited follow-up, further prospective studies with larger cohorts are required to better define its long-term efficacy and safety.

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