IRIDEX

32 Peer-Reviewed Studies on MicroPulse® Transscleral Laser Therapy 2010 - 2020

Peer-Reviewed Studies on
MicroPulse® Transscleral Laser Therapy

Name of Study and Authors	Glaucoma Type	Glaucoma Stage	Mean Age (Years)	# of patients # of eyes	Treatment Parameters*	Follow-up (Months)	IOP Reduction (mmHg)	Medication Decrease	Success Rates	Conclusions & Observations
(1) MicroPulse Transscleral Diode Laser Cyclophotocoagulation in the Treatment of Refractory Glaucoma. Tan AM, (Chew R), etl al. 2010	NVG, POAG, PACG, aphakic, silicone oil induced, juvenile	Advanced	63.2	38 patients 40 eyes	2000 mW 100 secs (50 secs per hemisphere) Avoided 3 and 9 o'clock positions and any area of thinned sclera	17.3 ± 2.0 (12 to 18)	38.7% from 40.1 ± 11.6 mmHg at baseline to 24.6 ± 9.6 mmHg at last follow-up	0.8 (mean) (from 2.1 to 1.3) 6 pts who required acetazolamide preop were able to stop day 1 post laser	72.7% after a mean of 1.3 treatment sessions	Micropulse TSCPC is a safe and effective method of lowering IOP in cases of refractory glaucoma and is comparable with conventional TSCPC.
(2) MicroPulse versus Continuous Wave Transscleral Diode Cyclo-photocoagulation in Refractory Glaucoma: A Randomized Exploratory Study. Aquino MC, et al. 2015	POAG, PACG, NVG, silicone oil, aphakic, traumatic	Advanced	MicroPulse: 63.5 CW: 66	48 patients 48 eyes MicroPulse: 24 eyes CW: 24 eyes	2000 mW 50 secs per hemisphere Avoided 3 and 9 o'clock positions	18	45% in both groups	from 2 to 1 in both groups	MicroPulse: 75 % @12 months CW: 52% @18 months	Diode transscleral cyclophoto-coagulation in both micropulse and continuous modes was effective in lowering intraocular pressure. The micropulse mode provided a more consistent and predictable effect in lowering intraocular pressure with minimal ocular complications.
(3) Long-term Efficacy of MicroPulse Diode Transscleral Cyclophoto-coagulation in the Treatment of Refractory Glaucoma. Aquino MC, et al. 2016	POAG, PACG, NVG, juvenile, secondary	Advanced	59.9	14 patients 14 eyes	2000 mW 50 secs per hemisphere	78	39 % (mean)	0.7 (mean) (from 1.8 to 1.1)	67% based on 14 pts @ 39% IOP drop	Micropulse diode transscleral cyclophotocoagulation was effective in the long term IOP control of refractory glaucoma.
(4) Micropulse Cyclophoto-coagulation: Initial Results in Refractory Glaucoma. Emanuel ME, et al. 2017	POAG, CAC, PXF, pigment dispersion, uveitic/ inflammatory, mixed mechanism, unspecified, traumatic, NVG, other secondary glaucoma, aphakic glaucoma	Refractory	74 (13 to 98)	84 patients 84 eyes	Mean Power 1939 mW (range, 1600 – 2000 mW) Mean Time 319 sec (160x2 per each hemisphere) Most patients received one 360° treatment (range, 180 to 260°) Avoided 3 and 9 o'clock positions.	Mean 4.3 (1 to 12)	41.2%	1.3	Not noted	The outcomes of our study are promising, with good evidence of the IOP-lowering effects of MP-TSCPC and decreased need for ocular antihyper-tensive medications postlaser at 6 months. Eyes with limited visual potential or at high risk for incisional glaucoma surgery can successfully be treated with MP-TSCPC as a reasonable and effective alternative to traditional CPC serve adequately as bridge treatment while the patient waits for a more definite treatment.

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(5) Outcome of MicroPulse Laser TSCPC on Pediatric vs Adult Glaucoma Patients Lee JH, et al. 2017	Adult: POAG; secondary: steroid, post corneal transplant, and trauma; aphakic, NVG, congenital Pediatric: Sturge-Weber syndrome, aphakic, The Peter anomaly, persistent hyperplastic primary vitreous, primary congenital	Moderate to advanced	60.6	34 patients 36 eyes	2000 mW 160 secs per hemisphere	12	Adults: 33.2% (mean) Pediatric: 21% (mean)	0.5 (from 3.0 to 2.5)	Adults: 72.2% Pediatric: 22.2%	MP-TSCPC is a safe procedure in pediatric and adult glaucoma patients, but the IOP reduction does not last long in pediatric patients.
(6) Micropulse versus Continuous Wave Transscleral Cyclophotocoagulation in Refractory Pediatric Glaucoma Abdelrahman AM, et al. 2018	PCG, phakia/pseudophakia, aniridia, Peter's anomaly, microspherophakia, Sturge-Weber syndrome	Advanced	MicroPulse: 67.8 ± 48 months CW: 61.3 ± 38.3 months	36 patients 45 eyes MicroPulse: 17 eyes CW: 28 eyes	2000 mW 100 to 120 secs Avoided 3 and 9 o'clock positions	6	MicroPulse: 63% ± 28% CW: 67% ± 25%	From 2 – 4 meds to 0 – 4 meds	MicroPulse: 71% CW: 46%	Both the MP-CPC and CW-CPC are effective in lowering the IOP in children with refractory glaucoma. However, the rate of complications, pain, and inflammation seem to be lower with the micropulse mode, making it a safer alternative for cyclophotocoagulation, especially since retreatments are often needed.
(7) Choroidal Thickness Increase after MicroPulse Transscleral Cyclophotocoagulation Barac R, et al. 2018	POAG, NVG, PACG, juvenile, trauma, RD surgery	Broad range	50 (25 to 85)	22 patients 22 eyes	2000 mW 80 to 130 secs per hemisphere	6	33.12% (from 35.23 mmHg to 23.56 mmHg at 6 months)	0.04 (from 3.14 to 3.1 at 6 months) Acetazolamide dropped from 1.18 to .27 dose per day (77.11%)	Majority of cases	MP-TSCPC is a safe and effective treatment option for a variety of glaucoma types. It can be used in patients with advanced and mild glaucoma cases. Visual acuity was generally not affected by this procedure. In responsive patients, a significant growth in choroidal thickness was noted, which was maintained at 6 months follow-up. Non-responsive patients had no choroidal thickness gain postoperatively. Choroidal thickness variation may be the result of the rise in uveoscleral outflow after MP-TSCPC.

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(8) Efficacy and Safety of MicroPulse Transscleral Cyclo-photocoagulation in Glaucoma Sanchez FG, (Grippo T), et al. 2018	Congenital, PXF, post-keratoplasty, mixed mechanism, aphakic, POAG, juvenile	Broad range	44.7 (11 to 79)	17 patients 22 eyes	2000 mW Surgeon 1: 90 secs per hemisphere Surgeon 2: 80 secs per hemisphere Surgeon 3: 50 secs per hemisphere	7.9 mean (6 to 14)	36 % in eyes that met the success criteria (6/22 eyes) (from 26.3 mmHg to 16.7 mmHg)	Differences not recorded	Success Rates Overall: 1 mo: 72.7 % 4 mo: 54.5 % (12/2 eyes) 6 mo: 41 % (9/22eyes) Final: 27.3 % (6/22 eyes) Success Rates Based on Duration: 90s: 75 % (3/4 pts); 80s: 21.4 % (3/14 pts); 50s: None (0/4 pts)	In a heterogeneous population of glaucoma (mostly congenital and pseudoexfoliation types), a low success rate (27.34 %) was obtained in the medium-term with a single session of Micropulse. Patients with longer treatment durations (90 seconds per hemisphere) achieved better results.
(9) Clinical Efficacy and Safety Profile of Micropulse Transscleral Cyclophotocoagulation in Refractory Williams AL, et al. 2018	POAG, CACG, PXF, uveitic, NVG, pigmentary	Advanced	70.2	79 patients 79 eyes	2000 mW The laser was delivered in a "stop-and-go" pattern (ie, it was held in place for 10 secs before being moved to the adjacent section of perilimbal conjunctiva) for 120 to 360 secs. Avoided 3 and 9 o'clock positions	Mean 7.8 ± 4.5	51 % average	.8 (from 2.3 to 1.5)	67 %	MP-TSCPC is an effective treatment for patients with refractory glaucoma. Shorter treatment times with more frequent repeat treatments, if necessary, should be considered given the incidence of significant vision loss in this study.
(10) Patient Outcomes Following MicroPulse Transscleral Cyclophotocoagulation Intermediate-Term Results Yelenskiy A, et al. 2018	POAG, NVG, uveitic, CACG, PK, ICE	Broad range	73 (19 to 96)	161patients 197 eyes	2000 mW 90 to 120 secs per hemisphere	12 mean (3 to 25)	27 % average (from 21.5 mmHg to 15.8 mmHg)	1 (from 3 to 2)	71 %	Our large longitudinal cohort study has provided evidence that MP-TSCPC is a safe and generally effective option in the treatment of POAG up to 12 months. This new method of delivery may be of help in patients who cannot take medications or delay incisional surgery. Patients at high risk of complications from incisional surgery can potentially use MP-TSCPC as an alternative. Given the safety profile (2 % complication rate in our study), MP-TSCPC can also complement prior tube shunt or filtration procedures.

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(11) Outcome of MicroPulse® Transscleral Photocoagulation in Different Types of Glaucoma Al Habash A, et al. 2019	NVG, POAG, secondary keratoplasty aphakia kerato-prosthesis, cyst excision ICS, trauma	Moderate to advanced	60 (13 to 89)	68 patients 71 eyes	2200 mW 120 secs, 10 passes per hemisphere. Each sweep in one direction was 12 secs over 5 clock hours in the superior and then in the inferior hemisphere. Avoided thinned sclera, cystic blebs and tube devices.	12 months/last follow-up, up to 24 months	Median 52% (0.0 – 89%)	1 from 5 (3 – 5) to 4 (2 – 4) All 44 pts taking Diamox pretreatment did not require it at last follow-up	95.7% total at 6 months and remained un-changed at last follow-up 91.5% in 66.2% of pts who were on MTMT with no surgical intervention.	MP-TSCPC demonstrated good efficacy and safety profiles with minimal vision-threatening complications in treating a variety of glaucoma types. It is an encouraging treatment option for patients as a primary procedure in cases of high IOP or medication intolerance, and can be used as a temporary treatment session for patients with high IOP refractory to MTMT before proceeding to incisional glaucoma surgery, which can help decrease the postoperative risks associated with an elevated IOP. The efficacy and safety of µP-TSCPC for patients who previously underwent other glaucoma surgery was very promising. It was an ideal treatment option for patients with failed incisional surgeries and very high IOP, where additional incisional surgery would have been too risky.
(12) Outcome of MicroPulse Laser in Treatment of Open Angle Glaucoma in a Peripheral Hospital in Rivers State, Nigeria: Our Initial Experience Awoyesuku EA, et al. 2019	POAG	Moderate to advanced	37.42 ± 7.00	12 patients 13 eyes	2000 mW 90 secs per hemisphere Avoided 3 and 9 o'clock positions	6	38.20% Mean IOP change over 6 months was 10.46 mmHg	11 out of 13 eyes showed a 50 % (3 to 1) reduction in the number of drops to achieve target IOP by 6 months	Not noted	MicroPulse Transscleral Cyclophoto-coagulation is a safe and effective way of managing glaucoma.

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(13) Micropulsed Diode Laser Cyclophotocoagulation in Recurrent Pediatric Glaucoma Elhefney EM, et al. 2019	PCG, aphakic, pseudophakic	Not noted	24 months (6 to 168 months)	29 patients 36 eyes	1750 - 2000 mW upper hemisphere 2000 mW lower hemisphere 55 - 65 secs per hemisphere Starting in the superior hemisphere the probe is placed behind the limbus and swept along the 6 clock hours every 10 secs, then repeated in the inferior hemisphere. Avoided 3 and 9 o'clock positions. The power was lowered in cases where scleral thinning was observed at the site of probe application.	15.08 ± 1.1	37.2 %	0.9	61 %	Micropulsed diode laser was proved to be a safe approach with relative effectiveness in controlling IOP in children with recurrent glaucoma. Though it fulfilled some of the expected achievements as being rapid, non-invasive, short learning curve and practical, the IOP control seemed to be tentative and the qualified success rate declined over time. The treatment exposed the eyes to conservative amount of energy that seemed to be free of complications, and can be considered as a temporary measure in managing selected patients who are poor candidates for surgery.
(14) Micropulse Transscleral Diode Laser Cyclophotocoagulation in Refractory Glaucoma: Short-Term Efficacy, Safety, and Impact of Surgical History on Outcomes Garcia GA, (Frances BA), et al. 2019	POAG, chronic CAG, congenital, juvenile open-angle, PXF, other secondary glaucoma, low tension, NVG, traumatic, mixed mechanism, pigment dispersion, uveitic/ inflammatory, aphakic	Refractory	65.8 ± 16.9	116 patients 116 eyes	2000 mW Avoided 3 and 9 o'clock positions and areas of thinned sclera. 2 surgeons: 180 secs in all cases; 2 surgeons: tailored the duration based on the severity of the glaucoma. higher treatment times for more complex and severe cases, and lower times for less complex cases.	6.3 ± 3.4	31.1 %	0.7	60 %	Micropulse transscleral diode laser cyclophotocoagulation has a significant short-term ocular hypotensive effect and favorable safety profile in eyes with refractory glaucoma. The probability of successful outcome was greater in eyes that had undergone prior traditional glaucoma surgery.

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(15) Prospective Evaluation of MicroPulse Transscleral Diode Cyclophotocoagulation in Refractory Glaucoma: 1 Year Results. Jammal AA, (Costa VP), et al. 2019	POAG, NVG, traumatic, silicone oil-induced	Advanced	61 ± 12.00	21 patients 21 eyes	2000 mW Duration was at the discretion of the surgeon, considering target IOP and glaucoma diagnosis. Avoided 3 and 9 o'clock positions	12	41.59%	from 3.48 to 2.00	66.67%	MicroPulse transscleral diode cyclophotocoagulation was safe and effective for reducing IOP in eyes with refractory and advanced glaucoma, with reduced need for ocular antihypertensive medication.
(16) MicroPulse Transscleral Cyclophotocoagulation: A Look at Long Term Effectiveness and Outcomes. Sarrafpour SS, et al. 2019	POAG, NVG, PXF	Advanced	73.7 mean (43 to 93)	62 patients 73 eyes	2500 mW for LP or worse; 2400 mW for HM or CF; 2250 mW for 20/80 – 20/400; 2000 mW for 20/20 – 20/70; 100 secs (50 per hemisphere, 4 to 6 passes per hemisphere); Avoided 3 and 9 o'clock positions	12 minimum, mean 1.8 years	46%	from 3.1 ± 1.1 to 2.5 ± 1.0 (19% reduction) 11 of 15 pts taking an oral CAI pre treatment did not require it 1 year post treatment	Not noted	This study provides evidence that MP-TSCPC is a clinically useful procedure associated with good long-term medication burden reduction and IOP reduction that follows a dose response pattern related to power use.
(17) Micropulse Transscleral Cyclophotocoagulation using a Standard Protocol in Patients with Refractory Glaucoma Naive of Cyclodestruction. Souissi S, et al. 2019	POAG, uveitic, congenital, post-traumatic, pigmentary, PXF, NVG, juvenile, malignant, CACG, Sturge-Weber syndrome	Moderate to advanced	60.2 ± 18.1 (15 to 94)	37 patients 37 eyes	2000 mW 80 secs per hemisphere. Total energy delivered: 100 J; Avoided 3 and 9 o'clock positions, blebs and tubes	9.7 ± 3.9	36% at 12 months	1.1; Withdrawal of acetazolamide achieved in 46% of cases (11/24).	35%	Using a standardized procedure, MicroPulse TSCPC allows a mild IOP decrease with a low rate of complications and thus achieves a relatively good profit risk benefit, mostly for moderately hypertensive refractory glaucoma. MicroPulse TSCPC was chosen as first-line surgical treatment for 27% of the patients because of the severity of their glaucoma to avoid potential complications related to sudden ocular decompression in case of incisional glaucoma surgery. 73% of patients had failed previous glaucoma surgery.

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(18) MicroPulse Transscleral Cyclophotocoagulation in Keratoplasty Eyes Subramaniam K, et al. 2019	POAG, PACG	Advanced	65 (25 to 91)	57 patients 61 eyes	2000 mW 80 or 90 secs per hemisphere	21 (2 to 35)	35% mean at 12 months	0.5 (from 2.7, range 0 – 4 to 2.2, range 0 – 4)	Graft survival was 94% at 1 year and 81% at 2 years after the initial laser treatment	MicroPulse transscleral cyclophoto-coagulation is a noninvasive alternative to glaucoma filtration surgery for IOP reduction in keratoplasty eyes.
(19) Outcomes of Micropulse Transscleral Cyclophoto-coagulation in Eyes with Good Central Vision Varikuti VNV, et al. 2019	POAG, CACG, other	Mild to advanced	68.80 ± 17.12	46 patients 61 eyes	2000 mW, 31.3% Laser Duration Superior hemifield: mean 78.39 ± 6.82 secs Inferior hemifield: mean 80.17 ± 1.30 secs 10 secs per hemifield sweep Avoided 3 and 9 o'clock positions	10.2 ± 3.1 months mean 49 eyes were followed to 12 months All pts had a min of 3 months follow-up	40.2% at 12 months with 85.4% of patients ha-ving an IOP reduction of ≥ 20%	0.82 ± 0.53 with 79.6% patients having a reduction of ≥ 1 medication at 12 months	75% complete success at 12 months 93.75% qualified success at 12 months	The significant reduction in IOP and glaucoma medication use, limited vision loss, less vision threatening complications and multiple logistical advantages, demonstrates MP-TSCPC as a safe and effective procedure. MP-TSCPC should be considered earlier in the management of glaucoma and can possibly be offered as an alternative to incisional glaucoma surgeries.
(20) Outcomes of MicroPulse Transscleral Cyclophoto-coagulation in Uncontrolled Glaucoma Patients Zaarour K, et al. 2019	POAG, secondary, PK, CACG, congenital, NVG, mixed mechanism, PXF, aphakia, aniridia, FHI, juvenile, unknown	Advanced	55.5 ± 22.9	69 patients 75 eyes	2000 mW 90 secs per hemisphere	Mean 13.2 ± 3.04 (1 to 15) 47 eyes (62.7% reached 15-month follow-up)	35.4%	0.5 (from 3.53 to 3.03) Acetazolamide decreased significantly up to 15 months	81.4% at 6 months 73.3% at 12 months	MP-TSCPC is an efficient noninvasive glaucoma treatment that achieves sustained IOP reduction and reduced need for ocular antihypertensive medications for up to 15 months. The optimal laser parameters to achieve the best success rate with the least side effects still need to be determined.

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(21) Micropulse Transscleral Cyclo-photocoagulation in Patients with Glaucoma: 1- and 2-Year Treatment Outcomes de Crom R, et al. 2020	POAG, NVG, Post vitrectomy with silicone oil, uveitis, trauma, complicated phaco, secondary IOL implant, perforating keratoplasty	Moderate to advanced	67.2 ± 14.5	136 patients 141 eyes	2000 mW 80 secs (when IOP <30 mmHg) 90 secs (when IOP >30 mmHg) Avoided 3 and 9 o'clock positions	Up to 24 months. All patients had 12 month minimum follow-up	28.6% at 12 months	1.1	80%	MicroPulse TSCPC is a safe and effective treatment for lowering both IOP and the number of IOP-lowering medications. It can also be considered as a good alternative treatment option for patients after failed incisional glaucoma surgery or patients who are at high risk for incisional surgery.
(22) The Effectiveness and Safety of Micropulse Cyclophoto-coagulation in the Treatment of Ocular Hypertension and Glaucoma Kaba Q, (Yuen D), et al. 2020	POAG, CACG, NVG 36, NTG, OHT, pigment dispersion, traumatic, and uveitic/ inflammatory, PFX, mixed mechanism	OHT, early, moderate, advanced	67 ± 13	214 patients 342 eyes	900 to 2800mW Power titrated at the discretion of surgeon based on VA, glaucoma severity, baseline IOP, target IOP and previous MP-CPC response. 80 secs per hemisphere; 160 secs total in each eye. 10-second sweeps Avoided 3 and 9 o'clock positions and sites with scleral thinning, glaucoma drainage device or filtering bleb.	12	23.70%	No Change	68%	In patients with OHT or glaucoma, MP-CPC demonstrated effectiveness and safety in IOP reduction sustained to one year. NTG and baseline IOP ≤21 mmHg subgroups demonstrated a more limited response. There is suggestion of a dose-response relationship with respect to laser power and repeat treatments. (399 MP-CPC surgeries were performed on 342 eyes of 214 patients).
(23) Clinical Outcomes of Micropulse Transscleral Cyclo-photocoagulation in Patients with a History of Keratoplasty Lee JH, et al. 2020	Post-PK, post-DSAEK	Not noted	65.9	28 patients 30 eyes	2000 mW Laser was applied throughout 180° over 160 seconds in each hemifield.	12	36.60%	0.5	70%	MP-TSCPC achieved desirable IOP control and success rates for postkeratoplasty patients while resulting in minimal complications and graft failure. It appears to be a safe and effective procedure in patients who received corneal transplant with one-year follow-up.

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(24) Assessment of Efficacy and Safety of Micropulse Diode Laser Treatment in Glaucoma: One Year Follow-Up Logioco C, et al. 2020	POAG, PACG, PXF, pigmentary, traumatic, NVG, congenital, aphakic, juvenile, cortisonic, previous or mixed surgery, Rieger syndrome	Mild, moderate, advanced	70 (51 to 77)	110 patients 143 eyes	2000 mW The probe must be moved slowly (10 – 15 secs) perpendicular to the surface between 3 and 9 o'clock during 70 – 90 secs per hemisphere	8.9 months (63 % completed >12 months)	31.0 %	1	89 %	The treatment with transscleral micropulse is a safe and efficient technique for use in glaucoma, attaining a reduction in IOP and decrease in need of antihypertensive medications within the first year following the procedure.
(25) Double-Session Micropulse Transscleral Laser (CYCLO G6) for the Treatment of Glaucoma Magacho L, et al. 2020	PXF, phakic, aphakic, POAG, congenital, post vitreoretinal surgery, post penetrating keratoplasty, CACG, NVG, pseudophakic, pigmentary, uveitic, ICE, juvenile, trauma	Mild to advanced	55.6 +/- 20.7 years (7 to 89)	76 patients 89 eyes	2000 mW 80 secs per treatment with double sessions in each hemifield - 2x each hemifield, alternating between upper and lower and upper and lower (total treatment time of 320 secs). 10 secs per hemifield. Avoided 3 and 9 o'clock positions.	16.7 ± 3.1	49 %	1.7 48 eyes were also taking 2.9 ± 0.8250 mg acetazolamide daily. At last evaluation, no eyes were taking oral acetazolamide.	86.5 %	MicroPulse P3 laser in two consecutive 80-s sessions was shown to be safe and effective in the treatment of glaucoma. In primary eyes, success was achieved in 90.3 % of the cases (3 eyes did not require medication) with 1.2 ± 0.5 procedures per eye (83.9 % with one, 9.7 % with two, and 6.5 % with three MicroPulse P3 laser procedures). Primary eyes required lower number of MicroPulse P3 laser procedures.
(26) Double-Session Micropulse Transscleral Laser (Cyclo G6) as a Primary Surgical Procedure for Glaucoma Magacho L, et al. 2020 GI Group: No previous glaucoma surgery (primary eyes) GII Group: Previous glaucoma surgery	POAG, post penetrating keratoplasty, post vitreoretinal surgery CACG, juvenile, PXF uveitic, trauma, post congenital cataract surgery, congenital, pigmentary, NVG, ICE	Mild to advanced	GI: 64.4 GII: 54.4	GI: 65 patients 84 eyes GII: 78 patients 101 eyes	2000 mW Double sessions from 80 to 120 secs per treatment in each hemifield. 10 secs per hemisphere Avoided 3 and 9 o'clock positions	6 minimum; ~ 12 in both groups	GI: 41.2 ± 21.1 % GII: 54.7 ± 15.2 %	GI: 1.7 GII: 1.4 All eyes (22 eyes in the GI group and 72 eyes in the GII group) were no longer taking Diamox at the last visit.	GI: 92.9 % GII: 87.1 %	Double-session MicroPulse P3 therapy could be considered as a safe and effective procedure to treat glaucoma in eyes that have not undergone any previous glaucoma surgery. Primary eyes achieved a success-rate similar to those with refractory glaucoma with fewer MicroPulse P3 procedures and fewer glaucoma medications.

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(27) Early Results of MicroPulse Transscleral Cyclophoto-coagulation for the Treatment of Glaucoma Nguyen AT, et al. 2020	POAG, PXF, CACG, congenital and/or juvenile	Moderate to advanced	69.2 (16 to 95)	95 patients 95 eyes	2000 to 2500 mW 90 secs per hemisphere	12	30.3 %	1.6 (from 3.0 ± 1.1 to 1.4 ± 1.0)	76.8 % (1 treatment) 100 % (1 to 5 retreatments)	Micropulse transscleral cyclophotocoagulation appears to be a safe and efficacious treatment for glaucoma refractory to topical medical therapy. Given its improved safety profile compared to conventional TSCPC, it deserves consideration as a primary procedure.
(28) Clinical Outcomes of Micropulse Transscleral Cyclophotocoagulation in Refractory Glaucoma-18 Months Follow-Up Preda MA, et al. 2020	OAG, PXF, NVG	Refractory	62.6 (20 to 88)	97 patients 100 eyes	2000 mW Group 1: IOP< 26 mmHg (80 secs duration) Group 2: IOP between 26 and 30 mmHg (100 secs duration) Group 3: IOP between 31 and 49 mmHg (120 secs duration) Group 4: IOP > 50 mmHg (130 secs duration)	18	41.8 %	31% of pts reduced meds by at least 1 at 18 mos follow-up	Group 1: 90.9 % Group 2: 70.0 % Group 3: 65.6 % Group 4: 84.6 %	Micropulse transscleral cyclophoto-coagulation is a non-invasive, repeatable laser procedure that offers both good and stable results in lowering IOP and decreases the use of antiglaucoma medications for up to 18 months.
(29) Micropulse Cyclophotocoa-gulation: A Multicenter Study of Efficacy, Safety, and Factors Associated with Increased Risk of Complications Radhakrishnan S, (Iwach AG), et al. 2020	POAG, mixed mechanism, PACG, exfoliation, NTG, steroid-induced, NVG, pigment dispersion, malignant, Sturge-Weber syndrome, congenital, trauma	Not noted	71 ± 14 years	143 patients 167 eyes	2000 mW The probe was applied 1-2 mm posterior to the limbus with a continuous "painting" motion in the superior and inferior hemispheres. Several laser "passes" were conducted per treatment, with the duration of each treatment being 80 secs with 2 to 4 180° treatments depending on surgeon preference. Total duration per treatment: 160 secs in 23 % (39/167), 240 secs in 32 % (53/167), and 320 secs in 45 % (75/167) of eyes. Avoided 3 and 9 o'clock positions, blebs and drainage devices.	11.9 ± 7.8 months, (range, 4 days - 26 months)	32% at 12 mos	0.5	36.60%	MPCP lowered IOP in the short-term but nearly half required additional IOP lowering intervention. Potential complications should be discussed in detail especially when the procedure is being considered for those with good visual acuity and early stage disease.

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MicroPulse® Transscleral Laser Therapy

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(30) Outcomes of MicroPulse Transscleral Cyclophoto-coagulation in Primary Open-Angle Glaucoma, Pseudoexfoliation Glaucoma, and Secondary Glaucoma Tekeli O, Kose HC. 2020	POAG, PXF, Post-PK, PPV secondary glaucoma, NVG, pseudophakic, uveitic/ inflammatory	End-Stage	59.37 ± 11.45	96 patients 96 eyes	2000mW 180° for 80 secs per hemifield Avoided 3 and 9 o'clock positions, areas of previous filtering surgery/tubes, and thin sclera.	12	40.5 %	0.5	66.6 %	MP-TSCPC is a safe and effective procedure for reducing IOP in POAG, PXG, and other types of refractory secondary glaucoma. Our retreatment rate was higher in refractory secondary glaucoma group than that in the POAG and the PXG groups. Given its relatively low risk and safety profile, MP-TSCPC could be applied in patients with good VA prior to tube shunt or filtration procedures. Therefore, MP-TSCPC may be used more widely in glaucoma therapy.
(31) MicroPulse Transscleral Cyclo-photocoagulation: Initial Results using a Reduced Energy Protocol in Refractory Glaucoma Vig N, et al. 2020	POAG, trauma, uveitis, NVG, complicated cataract-surgery, pigmentary, post-retinal detachment, aphakia, OHT (post retinal detachment surgery), CACG, primary congenital	Moderate to advanced or uncontrolled OHT	64.7 ± 15.1	29 patients 29 eyes	2000 mW 90 secs in eyes IOP > 30 mmHg 80 secs in eyes IOP < 30 mmHg Avoided sites of previous filtration surgery. 27 of 29 patients received 360°; 1 patient received 40 secs to inferior 180°; 1 patient received 70s to 270°.	6	30.6 %	0.41	58.6 %	MP-TSCPC at a decreased duration is effective at reducing intraocular pressure in ethnically diverse glaucoma patients refractory to previous glaucoma laser or surgeries at 6 months follow-up, with no significant complications. Further work is needed to confirm efficacy in the long term and to determine optimal settings.

*Using the Cyclo G6® Laser with a 31.3 % Duty Cycle and the MicroPulse P3® Device.

Peer-Reviewed Studies on
MicroPulse® Transscleral Laser Therapy

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(32) MP3 Plus: A Modified Micropulse Transscleral Cyclophototherapy Technique for the Treatment of Refractory Glaucoma Wong KYT, (Chew), et al. 2020	aphakic, ICE, NVG, phacomorphic, PACG, POAG, secondary ACG, secondary OAG, silicone oil-induced, steroid-induced, traumatic, uveitic	Refractory, Advanced glaucoma with poor visual potential	55.8 ± 17.7	29 patients 32 eyes	Two treatment phases: 1. 2000mW (31.3% duty cycle) 100 secs. The probe was applied with a continuous sliding motion, delivering an envelope of micropulses to the eyes, avoiding the 3 and 9 o'clock meridians, and any GDI or trabeculectomy sites. 2. Laser energy setting modified so that each patient received additional discrete pulses of 1.5 to 2.0W for 2 secs per spot (40.4% duty cycle). The laser energy was adjusted downwards by 0.25W if "pop" sounds were heard. Authors aimed for a total of 12 to 16 shots over both the superior and inferior perilimbal region.	12	44.0%	0.6	26%	MP3 Plus is effective and safe in lowering IOP in eyes with refractory glaucoma after previous failed MP-TCP. Although considered treatment failures in the analysis, MP3 Plus reduced IOP in these cases and was used as an interim procedure to aid them toward safer incisional surgery. In total, 11 out of the 32 (34.4%) eyes had MP3 Plus with a view for further glaucoma surgery as a more permanent measure. All 11 eyes went on to have the insertion of GDD after MP3 Plus during the study period. MP3 Plus was intentionally performed as a temporizing procedure and successfully lowered the IOP in these patients for safer incisional surgery.

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1. Tan AM, Chockalingam M, Aquino M, Lim Z, See J, Chew P. Micropulse transscleral diode laser cyclophotocoagulation in the treatment of refractory glaucoma. *Clin Experiment Ophthalmol*. 2010;38(3):266-72.
2. Aquino MC, Barton K, Tan AM, Sng C, Li X, Loon SC, Chew PT. Micropulse versus continuous wave transscleral diode cyclophotocoagulation in refractory glaucoma: A randomized exploratory study. *Clin Exp Ophthalmol*. 2015;43(1):40-6.
3. Aquino MC, Chew P, Long-term efficacy of micropulse diode transscleral cyclophotocoagulation in the treatment of refractory glaucoma. European Glaucoma Society. 2016.
4. Emanuel ME, Grover DS, Fellman RL, Godfrey DG, Smith O, Butler MR, Kornmann HL, Feuer WJ, Goyal S. Micropulse cyclophotocoagulation: Initial results in refractory glaucoma. *J Glaucoma*. 2017;26(8):726-729.
5. Lee JH, Shi Y, Amoozgar B, Aderman C, De Alba Campomanes A, Lin S, Han Y. Outcome of micropulse laser transscleral cyclophotocoagulation on pediatric versus adult glaucoma patients. *J Glaucoma*. 2017;26(10):936-939.
6. Abdelrahman AM, El Sayed YM. Micropulse versus continuous wave transscleral cyclophotocoagulation in refractory pediatric glaucoma. *J Glaucoma*. 2018;27(10):900-905.
7. Barac R, Vuzitas M, Balta F. Choroidal thickness increase after micropulse transscleral cyclophotocoagulation Romanian. *J Ophthalmol*. 2018;62(2):144-148.
8. Sanchez FG, Lerner F, Sampaolesi J, Noecker R, Becerra N, Iribarren G, Grippo TM. Efficacy and safety of micropulse(r) transscleral cyclophotocoagulation in glaucoma. *Arch Soc Esp Oftalmol*. 2018;93(12):573-579.
9. Williams AL, Moster MR, Rahmatnejad K, Resende AF, Horan T, Reynolds M, Yung E, Abramowitz B, Kuchar S, Waisbourd M. Clinical efficacy and safety profile of micropulse transscleral cyclophotocoagulation in refractory glaucoma. *J Glaucoma*. 2018;27(5):445-449.
10. Yelenskiy A, Gillette TB, Arosemena A, Stern AG, Garris WJ, Young CT, Hoyt M, Worley N, Zurakowski D, Ayyala RS. Patient outcomes following micropulse transscleral cyclophotocoagulation: Intermediate-term results. *J Glaucoma*. 2018;27(10):920-925.
11. Al Habash A, AlAhmadi AS. Outcome of MicroPulse(®) transscleral photocoagulation in different types of glaucoma. *Clinical Ophthalmology* (Auckland, N.Z.). 2019;(13):2353-2360.
12. Awoyesuku EA, Fiebai F. Outcome of micropulse laser in treatment of open angle glaucoma in a peripheral hospital in rivers state, nigeria: Our initial experience. *Journal of Advances in Medicine and Medical Research*. 2019;29(2):1-7.
13. Elhefney EM, Mokbel TH, Hagras SM, AlNagdy AA, Ellayeh AA, Mohsen TA, Gaafar WM. Micropulsed diode laser cyclophotocoagulation in recurrent pediatric glaucoma. *European Journal of Ophthalmology*. 0(0):1120672119858226. 2019. Published online ahead of print.
14. Garcia GA, Nguyen CV, Yelenskiy A, Akiyama G, McKnight B, Chopra V, Lu K, Huang A, Tan JCH, Francis BA. Micropulse transscleral diode laser cyclophotocoagulation in refractory glaucoma: Short-term efficacy, safety, and impact of surgical history on outcomes. *Ophthalmology Glaucoma*. 2019;2(6):402-412.
15. Jammal AA, Costa DC, Vasconcellos JPC, Costa VP. Prospective evaluation of micropulse transscleral diode cyclophotocoagulation in refractory glaucoma: 1 year results. *Arq Bras Oftalmol*. 2019;82(5):381-388.
16. Sarrafpour S, Saleh D, Ayoub S, Radcliffe NM. Micropulse transscleral cyclophotocoagulation: A look at long term effectiveness and outcomes. *Ophthalmology Glaucoma*. 2019;2167-171.
17. Souissi S, Baudouin C, Labbe A, Hamard P. Micropulse transscleral cyclophotocoagulation using a standard protocol in patients with refractory glaucoma naive of cyclodestruction. *Eur J Ophthalmol*. 2019;1120672119877586.
18. Subramaniam K, Price MO, Feng MT, Price FW, Jr. Micropulse transscleral cyclophotocoagulation in keratoplasty eyes. *Cornea*. 2019;38(5):542-545.
19. Varikuti VNV, Shah P, Rai O, Chaves AC, Miranda A, Lim BA, Dorairaj SK, Sieminski SF. Outcomes of micropulse transscleral cyclophotocoagulation in eyes with good central vision. *J Glaucoma*. 2019;28(10):901-905.
20. Zaarour K, Abdelmassih Y, Arej N, Cherfan G, Tomey KF, Khoueir Z. Outcomes of micropulse transscleral cyclophotocoagulation in uncontrolled glaucoma patients. *J Glaucoma*. 2019;28(3):270-275.
21. de Crom R, Slangen C, Kujovic-Aleksov S, Webers CAB, Berendschot T, Beckers HJM. Micropulse trans-scleral cyclophotocoagulation in patients with glaucoma: 1- and 2-year treatment outcomes. *J Glaucoma*. 2020;29(9):794-798.
22. Kaba Q, Somani S, Tam E, Yuen D. The effectiveness and safety of micropulse cyclophotocoagulation in the treatment of ocular hypertension and glaucoma. *Ophthalmol Glaucoma*. 2020;3(3):181-189.
23. Lee JH, Vu V, Lazcano-Gomez G, Han K, Suvannachart P, Rose-Nussbaumer J, Schallhorn J, Hwang D, Han Y. Clinical outcomes of micropulse transscleral cyclophotocoagulation in patients with a history of keratoplasty. *Journal of Ophthalmology*. 2020;20206147248.
24. Logioco C, Perrone LD, Caruso D, Albertazzi R, Valvecchia G, Zanutigh V. Assessment of efficacy and safety of micropulse diode laser treatment in glaucoma: One year follow-up. *Arch Soc Esp Oftalmol*. 2020;95(7):327-333.
25. Magacho L, Lima FE, Avila MP. Double-session micropulse transscleral laser (cyclo G6) for the treatment of glaucoma. *Lasers Med Sci*. 2020;35(7):1469-1475.
26. Magacho L, Lima FE, Avila MP. Double-session micropulse transscleral laser (cyclo G6) as a primary surgical procedure for glaucoma. *J Glaucoma*. 2020;29(3):205-210.
27. Nguyen AT, Maslin J, Noecker RJ. Early results of micropulse transscleral cyclophotocoagulation for the treatment of glaucoma. *Eur J Ophthalmol*. 2020;30(4):700-705.
28. Preda MA, Karancsi OL, Munteanu M, Stanca HT. Clinical outcomes of micropulse transscleral cyclophotocoagulation in refractory glaucoma-18 months follow-up. *Lasers Med Sci*. 2020;35(7):1487-1491.
29. Radhakrishnan S, Wan J, Tran B, Thai A, Hernandez-Siman J, Chen K, Nguyen N, Pickering T-D, Tanaka HG, Lieberman M, Wong P, Iwach AG. Micropulse cyclophotocoagulation: A multicenter study of efficacy, safety, and factors associated with increased risk of complications. *J Glaucoma*. 2020;29(12):1126-1131.
30. Tekeli O, Kose HC. Outcomes of micropulse transscleral cyclophotocoagulation in primary open-angle glaucoma, pseudoexfoliation glaucoma, and secondary glaucoma. *Eur J Ophthalmol*. 2020;1120672120914231.
31. Vig N, Ameen S, Bloom P, Crawley L, Normando E, Porteous A, Ahmed F. Micropulse transscleral cyclophotocoagulation: Initial results using a reduced energy protocol in refractory glaucoma. *Graefes Arch Clin Exp Ophthalmol*. 2020;258(5):1073-1079.
32. Wong KYT, Aquino CM, Macasaet AM, Suwandono ME, Chew PTK, Koh VTC. MP3 plus: A modified micropulse transscleral cyclophototherapy technique for the treatment of refractory glaucoma. *J Glaucoma*. 2020;29(4):264-270.

Indications for the MicroPulse P3 Device include, but are not limited to transscleral cyclophotocoagulation for the treatment of primary open-angle glaucoma, closed-angle glaucoma, and refractory glaucoma.

CACG:	Chronic Angle-Closure Glaucoma
CAI:	Carbonic Anhydrase Inhibitor
CF:	Count Fingers
CPC:	Cyclophotocoagulation
CW:	Continuous-Wave
DSAEK:	Descemet's Stripping Automated Endothelial Keratoplasty
FHI:	Fuchs Heterochromic Iridocyclitis
GDD:	Glaucoma Drainage Devices
HM:	Hand Motion
ICE:	Iridocorneal Endothelial Syndrome
MTMT:	Maximum Tolerated Medical Therapy
NTG:	Normal-Tension Glaucoma
NVG:	Neovascular Glaucoma
OHT:	Ocular Hypertension
LP:	Light Perception
PACG:	Primary Angle-Closure Glaucoma
PCG:	Primary Congenital Glaucoma
PK:	Penetrating Keratoplasty
PXF:	Pseudoexfoliation Glaucoma
POAG:	Primary Open-Angle Glaucoma
RD:	Retinal Detachment
TSCPC:	Transscleral Cyclophotocoagulation

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