Original Article

MicroPulse Transscleral Diode: An Effective Non-Surgical Treatment Alternate for Glaucoma

Mohammad Afzal Bodla[1], ,Maria Afzal Bodla[2], Nalain Syedah[3], Syed Imtiaz Ali[4]

ABSTRACT

Aim: To determine the efficacy and safety of MicroPulse transscleral laser therapy (MP-TLT) in different types of glaucoma.

Study Design: Interventional case series.

Duration and Settings of the Study: This study was conducted from October 2022 to May 2023 at Bodla Eye Care, Multan, Pakistan.

Methods: Patients with various types of glaucoma, such as open-angle glaucoma, closed-angle glaucoma, neovascular glaucoma, and pseudophakia glaucoma, with varying degrees of severity from mild to severe, were recruited. Pre- and post-treatment records included best-corrected visual acuity (BCVA), intraocular pressure (IOP), and number of glaucoma drugs taken. Records were kept on the number of therapy sessions, success rates, and postoperative complications. The follow-up records were recorded from October 2022 to June 2023.

Results: Twenty eyes from 20 patients were included in the final analysis. Fourteen (70%) patients were males and their ages ranged from to 20-65 years in the study group. The average IOP reduction rate was 43 % at 12 weeks of follow, which was statistically significant ($p<0.001$). MP-TLT is partially effective in patients with closed-angle glaucoma. In 4 of 15 patients, posterior uveitis developed in 3rd week which resolved with the use of topical and systemic steroids in the 5th week.

Conclusion: MicroPulse TLT is safe and effective for lowering IOP in a variety of glaucoma types with different severities. MicroPulse TLT has a lower complication rates.

Key Words: MicroPulse transscleral laser therapy; non-surgical management of glaucoma; efficacy.

INTRODUCTION

Glaucoma, a progressive optic neuropathy, is one of the main causes of irreversible blindness worldwide. Numerous cyclodestructive treatments have been developed to treat refractory glaucoma. Beckman and colleagues performed the first cyclodestructive laser procedure in 1972, and numerous other cyclodestructive procedures have since been developed.[1,2,3] MicroPulse Trans scleral diode laser (TLT) is a non-incisional laser therapy, which is used to treat glaucoma. The MicroPulse P3 Delivery Device and the Cyclo G6 Laser both use an infrared diode laser with an 810 nm wavelength, dividing the continuous energy wave into a sequence of pulses minimizing coagulative injury and tissue temperature increase.[3] According to the duty cycle, the laser is "ON" 31.3% of the time and "OFF" 68.7% of the time. Compared to the conventional transscleral cyclophotocoagulation (CPC) technique, MicroPulse technology results in a lower overall energy application over time and, when combined with a sweeping technique, produces a more homogenous energy distribution.[4,5,6] Moreover, the MicroPulse TLT has shown that this process is a safe and effective treatment for glaucoma, and recommendations on the best treatment regimens have not previously existed. Freshly redesigned delivery probes have an enhanced ergonomic design. The present conceptual understanding of the MicroPulse TLT, including its mechanism of action, indications, warnings on patient selection, and dosimetry, is summarized in this publication. MicroPulse TLT's suggested initial settings are 2500 mW, four to five sweeps with a 20-second sweep duration for each hemisphere, and 160 seconds each eye.[7,8,9]

In conventional techniques, the pigmented ciliary

Correspondence
Mohammad Afzal Bodla
Bodla Eye Care Multan, Pakistan
Mbodla35@gmail.com

[1]Bodla Eye Care Multan
[2]Department of Radiology Multan Medical and Dental College
[3]Pakistan Institute of Ophthalmology Alshifa Trust Eye Hospital Rawalpindi
[4]Amanat Eye Hospital Islamabad

COI: The authors have disclosed no conflict of interest.

body epithelium is targeted and destroyed, reducing the amount of aqueous humor produced. Significant collateral tissue damage from continuous laser treatment frequently leads to major side effects such as choroidal separation, uveitis, vision loss, persistent hypotony, and less frequently, phthisis bulbi and sympathetic ophthalmia.[8,10,11,12] Energy is delivered by MP-TLT in the form of a succession of brief, repeated pulses separated by rest intervals. It is believed that doing this will allow for a "cooling time" and thermal dissipation between bursts, potentially reducing collateral tissue damage. This study aimed to assess the efficacy (i.e., change in IOP after the procedure compared to baseline) and safety of MP-TLT using the original MicroPulse P3 delivery device.

METHODS

This was an interventional case series of consecutive patients diagnosed with glaucoma at Bodla Eye Care Multan. The participants were recruited between October 2022 and May 2023. Patients with refractory glaucoma at any stage who were on multiple topical and/or oral acetazolamide were included. TLT's average initial settings of 2.5 W, 4-5 sweeps with 20-25 seconds sweep duration for each hemisphere. The total exposure time was 120-160 seconds for each eye. The IOP was recorded, and any complications, such as corneal edema and uveitis, that developed with this treatment were also recorded.

Data analysis was performed using Statistical Package for Social Sciences (SPSS) version 26. For inferential analysis, a paired sample t-test was used to determine associations between outcome variables (reduction in IOP from baseline and topical antiglaucoma medications before and after TLT).

RESULTS

Twenty participants were included in this study, and their ages ranged from to 20-65 years. The male participants constituted 70% of the total sample. Age was categorized into four groups. No statistically significant IOP difference was found at 1st week after MicroPulse laser ($p = 0.212$). There was a statistically significant IOP reduction after 2nd 4th week ($p = 0.003$) and up to 24th week ($p < 0.001$). Figure 1 shows the trend in IOP reduction over the 24 weeks of follow-up,

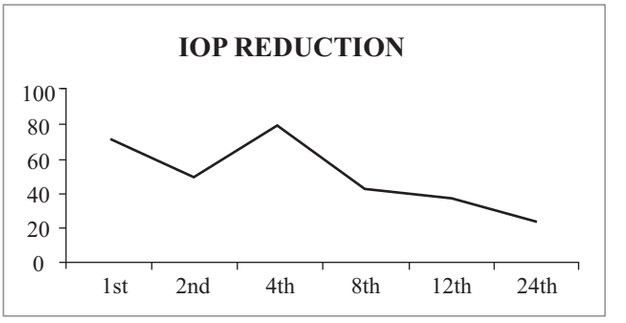

Figure 1: Trend in intraocular pressure after 24 weeks of treatment.

Table 1 shows the effects of TLT on anti-glaucoma medications. The number of antiglaucoma medications was reduced after treatment.

Table no. 1: The effect of TLT on antiglaucoma medications

Number of Antiglaucoma Medications	Pre TLT, n (%)	Post TLT, n (%)
Single drug	6 (30)	8 (40)
Two Drugs	8 (40)	7 (35)
Three Drugs	6 (30)	1 (5)
No Drug	0 (0)	4 (20)

TLT=Transscleral laser therapy, n=frequency, %=percentage

There was a successful reduction in IOP from baseline in all 20 eyes of 20 patients. Range in reduction in first week was noted 71% from baseline IOP, which ultimately became stable at 43 % at 8th week and 36 % at 24th week. In the case of adherent leukoma, two topical medications were stopped along with acetazolamide, and the patient was well maintained on one medicine. Neovascular glaucoma responded well in the first few weeks, but IOP started rising after the 10th week and was treated again with MicroPulse.

One patient (Age 22 yrs.), after laser showed posterior uveitis with vitreous hemorrhage, the patient's B scan suggested multiple vitreous opacities with vitreous hemorrhage. The patient was treated with topical systemic and subconjunctival steroids. Initially, the patient's visual acuity dropped to HM, while after the 8th week it started improving, and then on the 24th week it was

6/6 in the treated eye. The vitreous hemorrhage was absorbed, and there was no sign of vitritis. Another patient who did not respond to IOP reduction was treated again with a micropulse laser.

DISCUSSION

The MicroPulse TLT is an excellent tool for treating various forms of glaucoma. Before the development of MicroPulse, trabeculectomy and tube shunts were the two primary treatments available for patients with advanced glaucoma. These procedures had recognized postoperative complications, and postoperative care is frequently prolonged. The most recent version of MicroPulse is gaining popularity for several reasons, including its effectiveness, ease of use, minimal procedural training requirements, portability, and significantly lower postoperative care requirements than trabeculectomy or tube shunt. In general, postoperative discomfort is minimal, and the complication incidence is quite low. Additionally, not much preparation is required, and it takes only a few minutes to perform. This technology is frequently used because of its portability.[13,14,15,16] Currently, most surgeons reserve MicroPulse for the treatment of eyes with moderate-to-advanced glaucoma. In addition, it is useful in patients who are on multiple antiglaucoma medications and will need trabeculectomy in the future, or even in those patients in whom the eye is painful, such as neovascular glaucoma.

The current version of this technique, known as MicroPulse transscleral laser therapy (MP-TLT), successfully reduces IOP by enhancing uveoscleral and trabecular outflows.[17,18] There were very few complications, such as conjunctival chemosis and subconjunctival hemorrhage with photophobia, for the first few days. Rarely, it can cause anterior or posterior uveitis.[19,20] In our study, 20 eyes of 20 patients had moderate to advanced primary open-angle glaucoma (POAG), neovascular glaucoma, and glaucoma with adherent leukoma. In patients with POAG, there was a very good reduction in IOP and the number of topical antiglaucoma medications was reduced from over a period to 12-24 weeks, showing a very good success rate. A patient with adherent leukoma who was on triple medications with acetazolamide and presented with painful eyes was treated with one medication without acetazolamide. Two patients with angle-closure glaucoma had no effect on the MP-TLT laser. Considering the postoperative results of trabeculectomy and glaucoma valve surgery, MP-TLT proved to be superior to the above surgical procedures, and we can safely infer that the MP-TLT procedure is a very effective noninvasive and successful alternative for trabeculectomy and shunt procedures.

This study has some limitations, such as the lack of a comparison group, small sample size, and single-center design. Our recommendations are to include all glaucoma causes that are refractory to conventional treatments with comparative arm. A multicenter study will help us reach a definite conclusion.

CONCLUSION

MicroPulse transscleral laser therapy is an effective and safe treatment option for refractory glaucoma.

REFERENCES

1.Quigley HA, Broman AT. The number of people with glaucoma worldwide in 2010 and 2020. Br J Ophthalmol 2006;90(3):262-7. doi:10.1136/bjo.2005.081224.

2.Emanuel ME, Grover DS, Fellman RL, Godfrey DG, Smith O, Butler MR, et al. Micropulse cyclophotocoagulation: initial results in refractory glaucoma. J Glaucoma 2017;26(8):726-9. doi:10.1097/IJG.0000000000000715.

3.Beidoe G, Mousa SA. Current primary open-angle glaucoma treatments and future directions. Clin Ophthalmol 2012;6:1699-707. doi:10.2147/OPTH.S32933.

4.Chen DZ, Sng CC. Safety and efficacy of microinvasive glaucoma surgery. J Ophthalmol 2017;2017(1):3182935. doi: 10.1155/2017/3182935.

5.Tan AM, Chockalingam M, Aquino MC, Lim ZI, See JL, Chew PT. Micropulse transscleral diode laser cyclophotocoagulation in the treatment of refractory glaucoma. Clin Exp Ophthalmol 2010;38(3):266-72. Doi: 10.1111/j.1442-9071.2010.02238.x.

6.Lee JH, Shi Y, Amoozgar B, Aderman C, Campomanes AD, Lin S, et al. Outcome of micropulse laser transscleral cyclophotocoagulation on pediatric versus adult glaucoma patients. J Glaucoma 2017;26(10):936-9.Doi:10.1097/IJG.0000000000000757.

7.Sanchez FG, Lerner F, Sampaolesi J, Noecker R, Becerra N, Iribarren G, et al. Efficacy and safety of Micropulse® transscleral cyclophotocoagulation in glaucoma. Arch Soc Esp Oftalmol (Engl Ed)2018;93(12):573-9.Doi:10.1016/j.oftal.2018.08.003.

8.Al Habash A, AlAhmadi AS. Outcome of MicroPulse® transscleral photocoagulation in different types of glaucoma. Clin Ophthalmol 2019;13:2353-60. Doi: 10.2147/OPTH.S226554.

9.Nguyen AT, Maslin J, Noecker RJ. Early results of micropulse transscleral cyclophotocoagulation for the treatment of glaucoma. Eur J Ophthalmol 2020;30(4):700-5. Doi: 10.1177/1120672119839303.

10.Sarrafpour S, Saleh D, Ayoub S, Radcliffe NM. Micropulse transscleral cyclophotocoagulation: a look at long-term effectiveness and outcomes. Ophthalmol Glaucoma 2019;2(3):167-71. Doi:10.1016/j.ogla.2019.02.002.

11.Souissi S, Baudouin C, Labbé A, Hamard P. Micropulse transscleral cyclophotocoagulation using a standard protocol in patients with refractory glaucoma naive of cyclodestruction. Eur J Ophthalmol 2021;31(1):112-9. Doi: 10.1177/1120672119877586.

12.Varikuti VN, Shah P, Rai O, Chaves AC, Miranda A, Lim BA, et al. Outcomes of micropulse transscleral cyclophotocoagulation in eyes with good central vision. J Glaucoma 2019;28(10):901-5. Doi:10.1097/IJG.0000000000001339.

13.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):270-5. Doi: 10.1097/IJG.0000000000001174.

14.Aquino MC, Barton K, Tan AM, Sng C, Li X, Loon SC, et al. Micropulse versus continuous wave transscleral diode cyclophotocoagulation in refractory glaucoma: a randomized exploratory study. Clin Exp Ophthalmol 2015;43(1):40-6.Doi:10.1111/ceo.12360.

15.Fea AM, Bosone A, Rolle T, Brogliatti B, Grignolo FM. Micropulse diode laser trabeculoplasty (MDLT): A phase II clinical study with 12 months follow-up. Clin Ophthalmol 2008;2(2):247-52. doi:10.217/opth.s2303.

16.Hodge WG, Damji KF, Rock W, Buhrmann R, Bovell AM, Pan Y. Baseline IOP predicts selective laser trabeculoplasty success at 1 year post-treatment: results from a randomised clinical trial. Br J Ophthalmol 2005;89(9):1157-60. doi:10.1136/bjo.2004.062414.

17.Mansberger SL, Hughes BA, Gordon MO, Spaner SD, Beiser JA, Cioffi GA, et al. Ocular Hypertension Treatment Study Group. Comparison of initial intraocular pressure response with topical β-adrenergic antagonists and prostaglandin analogues in African American and white individuals in the ocular hypertension treatment study. Arch Ophthalmol 2007;125(4):454-9. doi: 10.1001/archopht.125.4.454.

18.Radhakrishnan S, Wan J, Tran B, Thai A, Hernandez-Siman J, Chen K, et al. Micropulse cyclophotocoagulation: a multicenter study of efficacy, safety, and factors associated with increased risk of complications. J Glaucoma 2020;29(12):1126-31. doi: 10.1097/IJG.0000000000001644.

19.Tekeli O, Köse HC. Outcomes of micropulse transscleral cyclophotocoagulation in primary open-angle glaucoma, pseudoexfoliation glaucoma, and secondary glaucoma. Eur J Ophthalmol 2021;31(3):1113-21. doi:10.1177/1120672120914231.

20.Varikuti VN, Shah P, Rai O, Chaves AC, Miranda A, Lim BA, et al. Outcomes of micropulse transscleral cyclophotocoagulation in eyes with good central vision. J Glaucoma 2019;28(10):901-5. doi:10.1097/IJG.0000000000001339.