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ORIGINAL RESEARCH

Micropulse Cyclophotocoagulation versus Ultrasound Cycloplasty in a Tertiary Eye Care Center in Riyadh, Saudi Arabia

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Purpose: To compare the efficacy, safety and outcomes of micropulse cyclophotocoagulation (MP-CPC) to ultrasound cycloplasty (UCP) in patients referred to a tertiary eye care center in Riyadh, Saudi Arabia.

Patients and Methods: A retrospective study evaluated data from patients who had undergone MP-CPC or UCP from January 2017 to October 2023. Patients who lost to follow up and patients with incomplete medical reports were excluded from the study. Data was collected for day 1, 2nd week, 1 month and 3, 6, and 12 months postoperatively. At each visit, data was collected on intraocular pressure (IOP), corrected distance visual acuity (CDVA), medications and possible complications. Data was compared between groups. $P<0.05$ was considered statistically significant.

Results: Out of 139 eyes, 65 underwent UCP, and 74 underwent MP-CPC. IOP in the UCP group decreased from 29.67±9.82 mmHg preoperatively to 21.00±6.78 mmHg at one year postoperatively and in the MP-CPC group, IOP decreased from 28.44±9.46 mmHg to 20.41±8.77 mmHg respectively. In the UCP group, at the 1-year follow-up, vision remained unchanged from the preoperative levels in 6 eyes (27.3%), while 2 eyes (9.1%) lost 1 line of vision, and 8 eyes (36.4%) experienced a loss of ≥2 lines. In the MP-CPC group, at the 1-year follow-up, vision remained unchanged in 24 eyes (43.6%), 2 eyes (3.6%) lost 1 line, and 20 eyes (36.4%) had a loss of ≥2 lines. The number of antiglaucoma medications at 1 year postoperatively did not differ between groups. The qualified success rate at 1 year was similar between groups.

Conclusion: Both UCP and MP-CPC are safe and effective for reducing IOP in refractory glaucoma, with similar reductions observed between the two techniques. Visual outcomes and qualified success rates were comparable between UCP and MP-CPC.

Keywords: micropulse, CPC, cyclophotocoagulation, ultrasound cycloplasty, refractory glaucoma

Introduction

Glaucoma is a leading cause of irreversible blindness globally. In 2010, an estimated 2.1 million individuals worldwide became blind due to glaucoma. Notably, a recent study in Saudi Arabia reported a high prevalence of legal blindness among glaucoma patients, approximately 26.6%.[1,2] Ultrasound-based glaucoma therapy was initially explored in the 1980s, with high-intensity focused ultrasound (HIFU) utilized to create focal scleral lesions and reduce intraocular pressure (IOP).[3] The mechanism of action involves thermal coagulation necrosis of the ciliary body, thereby decreasing aqueous humor inflow.[4] Evidence also suggests involvement of the suprachoroidal and trans-scleral uveoscleral outflow pathways.[5,6] A potential advantage of ultrasound over traditional laser-based cyclodestruction is its reduced impact on adjacent tissues due to the ability to focus energy through optically opaque media, and its independence from tissue pigmentation for achieving a thermal effect, unlike non-focused lasers (eg, diode laser for cyclophotocoagulation) or microwave heating. However, early HIFU was primarily indicated for advanced or refractory glaucoma due to its unpredictable dose-response, operator dependency, poor reproducibility, and limited selectivity for the target tissue.[7]

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Concurrently with the development of ultrasound techniques, laser cyclophotocoagulation has also evolved. Micropulse cyclophotocoagulation (MP-CPC) is a more recent iteration that utilizes a duty cycle to deliver laser energy in short pulses, interspersed with longer pauses, aiming to reduce thermal damage to surrounding tissues compared to continuous-wave laser application.[8]

Despite the theoretical benefits and continued development of both ultrasound and laser-based approaches, managing refractory glaucoma remains a challenge. HIFU saw limited long-term adoption after the mid-1990s, largely due to procedural complexity and the cumbersome design of commercially available systems.[9] More recently, ultrasound technology has been refined with the introduction of ultrasound cycloplasty (UCP), a device featuring miniature transducers that deliver controlled high-intensity focused ultrasound to induce ciliary body coagulation. Compared to conventional diode laser cyclophotocoagulation, UCP offers more precise energy delivery, potentially minimizing damage to surrounding structures and exhibiting a more favorable safety profile with a more predictable IOP-lowering effect, as suggested by several studies.[10] The automated nature of UCP also reduces operator dependence, potentially contributing to more consistent outcomes.[11]

The use of non-invasive procedures such as UCP provides hope for more predictable results and fewer complications than traditional surgical options, making it an area of ongoing research with the potential to advance glaucoma management. To the best of our knowledge, no comparative study has been conducted on the efficacy and safety of UCP versus micropulse cyclophotocoagulation (MP-CPC) in the Saudi population. The aim of our study is to compare the efficacy and safety of the use of UCP to MP-CPC in a cohort of Saudi patients, and to provide preliminary data to establish a foundation on which future studies can be conducted.

Materials and Methods

Consent and Ethics Approval

This study was approved by the Institutional Review Board (IRB) at King Khaled Eye Specialist Hospital (KKESH), Riyadh, Saudi Arabia (Approval No. 23127-RP). Due to the retrospective nature of this study, patient consent to review medical records was not required by the IRB. All patient data were handled with strict confidentiality and in compliance with the principles of the Declaration of Helsinki.

Inclusion and Exclusion Criteria

Patients who underwent UCP of any age between 2017 and 2023 at KKESH were included in this study using a consecutive sampling method. A representative sample of patients who underwent MP-CPC at KKESH from 2017 to 2023, with no age limit, was selected using a simple random sampling method. Patients with incomplete medical records were excluded.

Description of Techniques

This study compares two techniques used in the management of refractory glaucoma: micropulse cyclophotocoagulation (MP-CPC) and ultrasound cycloplasty (UCP).

Ultrasound Cycloplasty (UCP)

This technique utilizes controlled high-intensity focused ultrasound to induce ciliary body coagulation. The intended outcome of this process is to reduce aqueous humor inflow, consequently lowering intraocular pressure (IOP). It was performed with the following parameters: frequency 20.310 MHz, power 6.3 W, transducer diameter 12 mm, and 8 sections of the ciliary body treated.

Micropulse Cyclophotocoagulation (MP-CPC)

This is a laser-based technique that delivers laser energy in short pulses, interspersed with longer pauses. This delivery method aims to minimize thermal damage to surrounding tissues in comparison to continuous-wave laser application. The settings for the procedure were: 270 degrees of the ciliary body treated, sparing the superotemporal quadrant, power of 2000 mW, and duration of 40 seconds.

Choice of Procedure

Due to the retrospective nature of this study, the choice between UCP and MP-CPC was based on the treating physician's clinical judgment at the time of treatment. Factors that may have influenced this decision could include the severity of glaucoma, prior surgical history, patient preference, and availability of the procedures. These decisions were made by glaucoma consultants within the Glaucoma Department at KKESH. There were no standardized protocols in place that dictated the choice of one procedure over the other.

Success Rate

Complete success was defined as an intraocular pressure (IOP) reduction of ≥20% from the baseline value, with an IOP > 5 mmHg, and no additional IOP-lowering agents.

Qualified success was defined as IOP reduction of ≥20% from the baseline value, with an IOP > 5 mmHg, and with additional IOP-lowering agents.

Safety Assessment

Corrected distance visual acuity (CDVA) was assessed at baseline and at each follow-up visit (day 1, 2 weeks, 1 month, 3 months, 6 months, and 12 months postoperatively) and converted to LogMAR for analysis. A decrease in visual acuity of more than 2 lines on a Snellen chart or progression to no light perception (NLP) was recorded as a potential complication and will be reported in the results section.

Statistical Analysis

Corrected distance visual acuity (CDVA) was converted into a logarithm of the minimum angle of resolution (LogMAR) for analysis. Baseline values for all parameters presented in Table 1 were obtained through a retrospective review of patients' electronic medical records. Specifically, baseline Intraocular Pressure (IOP) values were recorded from the last

Table 1 Comparison of Baseline Demographic and Clinical Characteristics Between Ultrasound Cyclo-Plasty and Micropulse Cyclophotocoagulation Groups

Parameter	Disease Category / IOP Range / Visual Level	UCP	MP-CPC	P-value
Eyes		65	74	
Gender (m/f)		32/29	43/28	0.382
Age (years)		58.73±17.67 (17.1 to 92.7)	52.45±20.45 (12.9 to 88.8)	0.119
Diagnosis	POAG	23 (35.9%)	10 (13.5%)	0.002
	SOAG	13 (20.3%)	18 (24.3%)	
	NVG	9 (14.1%)	4 (5.4%)	
	JOAG	2 (3.1%)	1 (1.4%)	
	SACG	3 (4.7%)	3 (4.1%)	
	PFXG	6 (9.4%)	5 (6.8%)	
	PCG	3 (4.7%)	10 (13.5%)	
	Others[1]	5 (7.8%)	23 (31.1%)	
Baseline IOP (mmHg)		28.17±9.69 (13.00 to 54.00)	29.11±10.11 (9.00 to 54.00)	0.521
Baseline IOP stratification	9.0 to 21.0	19 (29.7%)	21 (28.4%)	0.812
	22.0 to 29.0	21 (32.8%)	20 (27.0%)	
	30.0 to 39.0	13 (20.3%)	19 (25.7%)	
	40.0 to 49.0	10 (15.6%)	11 (14.9%)	
	≥50	1 (1.6%)	3 (4.1%)	

(*Continued*)

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Table 1 (Continued).

Parameter	Disease Category / IOP Range / Visual Level	UCP	MP-CPC	P-value
Baseline number of anti-glaucoma agents		3.28±1.27	3.07±1.25	0.164
Baseline CDVA (LogMAR)		1.06±0.86	1.73±0.84	<0.001
Baseline CDVA stratification	Equal or better than 20/400	44 (74.6%)	21 (32.3%)	<0.001
	CF	2 (3.4%)	2 (3.1%)	
	HM	8 (13.6%)	32 (49.2%)	
	LP	3 (5.1%)	8 (12.3%)	
	NLP	2 (3.4%)	2 (3.1%)	
Follow-up time		11.17±3.06	16.50±6.42	<0.001

Notes: [1]Others: includes various less common and advanced glaucoma types where a specific diagnosis was not always determined (eg, combined mechanism glaucoma).

Abbreviations: UCP, ultrasound cyclo-plasty; MP-CPC, micropulse cyclophotocoagulation; m, males; f, females; POAG, primary open-angle glaucoma; SOAG, secondary open-angle glaucoma; NVG, neovascular glaucoma; JOAG, Juvenile open-angle glaucoma; SACG, secondary angle-closure glaucoma; PSXG, pseudoexfoliation glaucoma; PCG, primary congenital glaucoma; IOP, intraocular pressure; CDVA, corrected distance visual acuity; CF, count finger; HM, hand motion; LP, perception of light; NLP, no perception of light.

pre-operative clinic visit prior to the UCP or MP-CPC procedure; baseline CDVA measurements were taken from the pre-operative ophthalmic examination; and baseline medication use was determined by reviewing the patients' medication lists documented in their charts at the pre-operative visit. This data was then extracted and entered into our study database for analysis. Quantitative data were summarized with mean, standard deviation, and range. Categorical data were summarized with counts and percentages. The normal distribution of data was evaluated with the Shapiro–Wilk test. Paired normally distributed data were compared with the paired *t*-test. Paired non-normally distributed data were compared with the Wilcoxon signed ranks test. Unpaired normally distributed data were compared with the unpaired *t*-test. Unpaired non-normally distributed data were compared with the Mann–Whitney *U*-test. Categorical data were compared with the chi-squared test or Fisher's exact test. $P < 0.05$ was considered statistically significant. Statistical analysis was performed with IBM SPSS Statistics for Windows (Version 27.0; IBM Corp., Armonk, NY, USA). Figures were created using Excel (2019, Microsoft Corp. Redmond, WA, USA).

Results

A cohort of 139 eyes was included in the study, representing 132 patients (75 males and 57 females). The mean age of the participants was 55.35 ± 19.40 years, ranging from 12.88 years to 92.65 years. There were 65 eyes that underwent UCP (UCP group) and 74 eyes underwent MP-CPC (MP-CPC group). Table 1 presents the demographics and clinical characteristics of both groups. The most common diagnoses were primary open-angle glaucoma (POAG), secondary open-angle glaucoma (SOAG), neovascular glaucoma (NVG) (Table 1). Additional diagnoses comprised aphakic glaucoma, post-keratoprosthesis glaucoma, uveitic glaucoma, steroid responder glaucoma, Fuchs heterochromic iridocyclitis (FHIC)-associated glaucoma, absolute glaucoma, glaucoma in a blind painful eye with elevated IOP, and pseudophakic glaucoma. Both groups had comparable distribution of gender, age, baseline IOP, and the number of baseline anti-glaucoma agents (Table 1). However, there were statistically significant differences in the type of glaucoma ($P = 0.002$) and baseline CDVA ($P < 0.001$) (Table 1). The baseline IOP was 28.17 ± 6.69 mmHg in the UCP group and 29.11 ± 10.11 mmHg In the MP-CPC group ($P = 0.521$) (Table 1). Baseline CDVA was 1.06 ± 0.86 LogMAR in the UCP group and 1.73 ± 0.84 LogMAR in the MP-CPC group ($P < 0.001$) (Table 1).

Intraocular Pressure

Table 2 presents a comparison between follow-up IOP and preoperative IOP, the IOP reduction for each group. On the first day, both groups experienced a reduction in IOP (Table 2). In the UCP group, the IOP decreased from 28.16 ± 9.89 mmHg to 21.79 ± 9.07 mmHg, while in the MP-CPC group, it decreased from 28.99 ± 10.00 mmHg to 20.16 mmHg

Table 2 Comparison of Reduction of Intraocular Pressure Before and After Ultrasound Cyclo-Plasty and Micropulse Cyclophotocoagulation

Time	UCP				MP-CPC				P-value*
	N	Baseline IOP (mmHg)	Follow-up IOP (mmHg)	IOP Reduction (%)	N	Baseline IOP (mmHg)	Follow-up IOP (mmHg)	IOP Reduction (%)	
1 Day	61	28.16±9.89	21.79±9.07	18.70	67	28.99±10.00	20.16±6.69	25.43	0.216
2 Weeks	39	27.79±9.07	19.01±8.60	27.09	27	29.78±9.24	21.39±9.19	25.48	0.846
1 Month	42	28.57±9.55	19.34±9.42	30.31	55	28.01±10.05	21.05±8.92	16.66	0.054
3 Months	37	26.68±9.63	21.12±7.52	14.92	52	30.37±10.37	22.59±10.49	21.11	0.381
6 Months	39	28.56±9.81	19.94±7.63	24.61	60	29.09±9.78	20.73±9.57	22.59	0.790
1 Year	24	29.67±9.82	21.00±6.78	24.16	65	28.44±9.46	20.41±8.77	23.20	0.909

Notes: *the *P*-value assesses the significance of the difference in IOP reduction between UCP and MP-CPC. $P < 0.05$ is statistically significant.
Abbreviations: UCP, ultrasound cyclo-plasty; MP-CPC, micropulse cyclophotocoagulation; IOP, intraocular pressure.

(Table 2). Thereafter, the reduction in IOP was similar across follow-up visits for both groups ($P > 0.050$, all comparisons). At 1 year postoperatively, the IOP was 21.00 ± 6.78 mmHg in the UCP group, showing a 24.16% reduction, while in the MP-CPC group, it was 20.41 ± 8.77 mmHg which was a 23.20% reduction ($P = 0.909$). The IOP changes over time were similar in both groups (Figure 1).

Use of Anti-Glaucoma Medications

Table 3 compare the number of anti-glaucoma agents before and after UCP and MP-CPC. In the UCP group, there was a transient statistically significant decrease in the number of anti-glaucoma agents on day 1 ($P < 0.001$). However, by one year, the number of agents returned to baseline values ($P = 0.704$). In the MP-CPC group, there was no statistically significant change observed on day 1 ($P = 1.000$) or during any follow-up visits, including the one-year visit ($P = 0.402$).

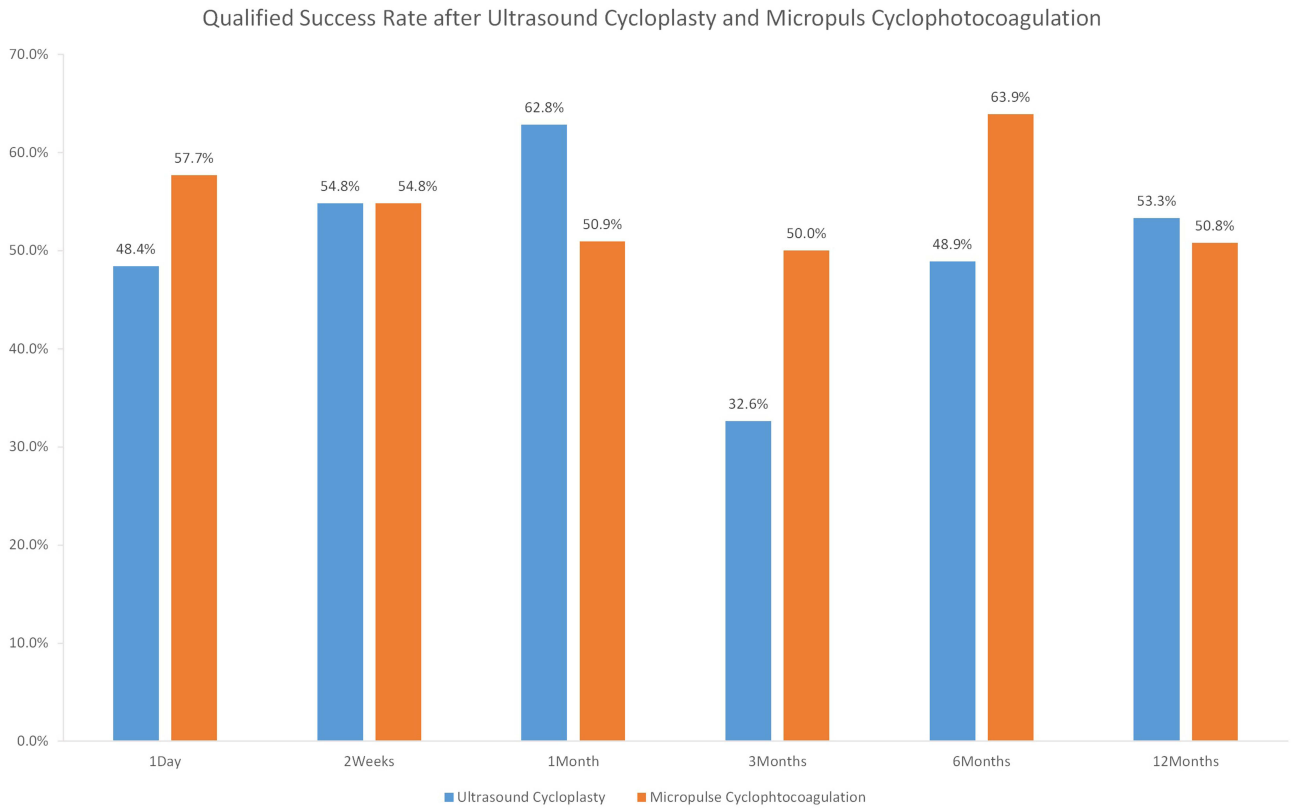

Figure 1 Qualified success rate after ultrasound cycloplasty and micropulse cyclophotocoagulation.

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Table 3 Number of Anti-Glaucoma Agents Before and After Ultrasound Cyclo-Plasty and Micropulse Cyclophotocoagulation

Time	UCP				MP-CPC				P-value*
	N	Baseline	Follow-up	Zero Agent n (%)	N	Baseline	Follow-up	Zero Agent n (%)	
1 Day	61	3.26±1.29	1.80±1.47	18 (29.5)	70	3.07±1.25	3.07±1.28	2 (2.9)	<0.001
2 Weeks	38	3.39±1.37	2.13±1.53	8 (21.1)	27	3.19±1.08	3.30±1.30	0 (0)	0.017
1 Month	43	3.19±1.31	2.40±1.24	5 (11.6)	58	3.14±1.37	3.22±1.41	1 (1.7)	0.081
3 Months	39	3.26±1.25	2.77±1.39	3 (7.7)	54	3.06±1.27	3.07±1.18	1 (1.9)	0.306
6 Months	38	3.42±1.08	2.95±1.35	0 (0)	62	3.15±1.30	3.03±1.33	4 (6.5)	0.294
1 Year	24	3.13±1.23	3.04±1.08	0 (0)	67	3.07±1.31	2.91±1.14	3 (4.5)	0.563

Notes: *the p-value assesses the significance of the difference in zero agent between UCP and MP-CPC. $P < 0.05$ is statistically significant.
Abbreviations: UCP, ultrasound cyclo-plasty; MP-CPC, micropulse cyclophotocoagulation; IOP, intraocular pressure.

Table 4 Comparison of Visual Acuity Before and After Ultrasound Cyclo-Plasty and Micropulse Cyclophotocoagulation

Time	Group	N	Baseline CDVA (LogMAR)	Follow-up CDVA (LogMAR)	*P*-value*	Vision			
						N	Unchanged n (%)	Loss 1 Line n (%)	Loss ≥2 Lines n (%)
1 Day	UCP	37	1.05±0.92	1.18±0.96	0.012	37	20 (54.1)	2 (5.4)	11 (29.7)
	MP-CPC	61	1.73±0.86	1.75±0.79	0.709	61	34 (55.7)	1 (1.6)	14 (23.0)
1 Month	UCP	35	1.01±0.83	1.09±0.88	0.095	35	15 (42.9)	3 (8.6)	8 (22.9)
	MP-CPC	48	1.82±0.87	1.84±0.84	0.650	48	27 (56.3)	2 (4.2)	9 (18.8)
3 Months	UCP	33	0.92±0.77	1.06±0.77	0.004	33	15 (45.5)	0 (0)	11 (33.3)
	MP-CPC	49	1.72±0.94	1.73±0.88	0.896	49	27 (55.1)	1 (2.0)	10 (20.4)
6 Months	UCP	35	1.03±0.83	1.24±0.91	0.010	35	12 (34.3)	3 (8.6)	12 (34.3)
	MP-CPC	50	1.68±0.92	1.80±0.92	0.092	50	22 (44.0)	1 (2.0)	19 (38.0)
1 Year	UCP	22	1.26±0.95	1.46±1.09	0.058	22	6 (27.3)	2 (9.1)	8 (36.4)
	MP-CPC	55	1.74±0.82	2.01±0.82	0.003	55	24 (43.6)	2 (3.6)	20 (36.4)

Notes: *the p-value assesses the significance of the difference in CDVA between baseline and follow-up readings per time per group. $P < 0.05$ is statistically significant.
Abbreviations: CDVA, corrected distance visual acuity; UCP, ultrasound cyclo-plasty; MP-CPC, micropulse cyclophotocoagulation.

Visual Acuity

Table 4 compare the visual acuity before and after UCP and MP-CPC. In the UCP group, there was a significant deterioration in visual acuity on day 1 ($P = 0.012$), at 3 months (p = 0.004), and at 6 months ($P = 0.010$) compared to baseline visual acuity. However, there was no significant change in visual acuity at 1 year ($P = 0.058$). In the MP-CPC group, a significant deterioration in visual acuity was observed only at 1 year ($P = 0.003$). In the UCP group, at the 1-year follow-up, vision remained unchanged from the preoperative baseline in 6 eyes (27.3%), while 2 eyes (9.1%) lost 1 line of vision, and 8 eyes (36.4%) experienced a loss of ≥2 lines. Similarly, in the MP-CPC group, at the 1-year follow-up, vision remained unchanged in 24 eyes (43.6%), 2 eyes (3.6%) lost 1 line, and 20 eyes (36.4%) had a loss of ≥2 lines.

Postoperative Management and Complications

In both the UCP and MP-CPC groups, 33.8% of eyes underwent additional surgery ($P = 1.000$), with no significant difference in the types of surgery performed between the groups ($P = 0.581$). Table 5 presents the comparisons of complete success, qualified success, and the frequency of surgeries following UCP and MP-CPC. Figure 1 illustrates the qualified success rates for both groups over time. Qualified success was achieved in 16 eyes (53.3%) in the UCP group, and 33 eyes (50.8%) in the MP-CPC group. In the UCP group, one eye experienced pain as a complication. However, in

Table 5 Comparison of Qualified Success and Eyes That Have Undergone Surgeries Following Ultrasound Cyclo-Plasty and Micropulse Cyclophotocoagulation

Parameter	Type of Surgery/ Period of Follow-up	UCP n (%)	MP-CPC n (%)	*P*-value
Total number of eyes		65	74	
Number of eyes that underwent glaucoma surgery		7 (10.8)	5 (6.8)	0.547
	Tube surgery (AGV)	4 (6.2)	4 (5.4)	
	AADI	2 (3.1)	0 (0)	
	GATT	1 (1.5)	0 (0)	
	PreserFlo	0 (0)	1 (1.4)	
Complete success rate	1 Day	7 (11.3)	1 (1.4)	0.025
	2 Weeks	2 (4.9)	0 (0)	0.503
	1 Month	2 (4.4)	0 (0)	0.181
	3 Months	0 (0)	0 (0)	-
	6 Months	0 (0)	3 (4.8)	0.261
	1 Year	0 (0)	1(1.5)	1.000
Qualified success rate	1 Day	30 (48.4)	41 (57.7)	0.301
	2 Weeks	23 (54.8)	17 (54.8)	1.000
	1 Month	27 (62.8)	29 (50.9)	0.309
	3 Months	14 (32.6)	26 (50.0)	0.099
	6 Months	22 (48.9)	39 (63.9)	0.164
	1 Year	16 (53.3)	33 (50.8)	0.829

Notes: Preserflo, a minimally invasive glaucoma drainage device. $P < 0.05$ is statistically significant.
Abbreviations: UCP, ultrasound cyclo-plasty; MP-CPC, micropulse cyclophotocoagulation; AGV, Ahmed glaucoma valve; AADI, aurolab aqueous drainage implant; GATT, gonioscopy-assisted transluminal trabeculotomy.

both groups there were no cases of conjunctival hyperemia, scleral impression, hypotony, choroidal detachment, mydriasis, anterior chamber inflammation, corneal edema, or subconjunctival hemorrhage.

Discussion

Ultrasound cycloplasty (UCP) has emerged as a technique for managing refractory glaucoma, with studies demonstrating its efficacy and safety. In our study, patients who underwent UCP achieved a mean IOP reduction of 21.00 ± 6.78 mmHg at 1-year postoperatively, representing a 24.16% decrease from baseline. This IOP reduction is comparable to the 20.41 ± 8.77 mmHg (23.2% decrease) observed in the MP-CPC group. Our UCP results show a similar magnitude of IOP reduction to that reported by Almobarak et al, who found a mean reduction of 18.22 ± 7.0 mmHg (35.51%) at the 12-month follow-up (p <0.01]).[12] This finding is consistent with the IOP reduction reported in the studies by Bolek et al (16.6 ± 2.7 mmHg; 27.2%) and Longfang et al (27.1 ± 11.0 mmHg; 29.2%).[13,14] In contrast, Torky et al reported a more substantial mean IOP decrease of 20.6 ± 8.7 mmHg, representing a 42.3 ± 16.7% reduction.[15] Studies on MP-CPC have also shown variable outcomes; Basto et al observed a 16.1 mmHg reduction in IOP at 12 months, while Preda et al reported a mean reduction of 22.77 ± 8.13 mmHg.[16,17]

In our study, there was no statistically significant difference between the groups regarding the number of IOP-lowering medications required. This finding is consistent with Bolek et al's study, that reported 16 out of 41 patients in the UCP group maintained the same number of baseline antiglaucoma medications.[13] Longfang et al also reported similar results for postoperative medications after UCP.[14] This is in contrast to the finding by Almobarak et al, who found a significant drop of the medications from 3.23 (±0.9) to 2.15 (±1.5) at the 12-month visit.[12]

In regards to the visual acuity, Bolek et al found no significant differences in visual acuity between MP-CPC and UCP for patients with refractory glaucoma.[13] However, in our study, there was a significant deterioration in visual acuity in the MP-CPC group at the 1-year follow-up visit ($p = 0.003$). Additionally, in the UCP group, 27.3% of eyes had unchanged vision from baseline, 9.1% lost 1 line, and 36.4% experienced a loss of ≥2 lines. In comparison, the MP-CPC group had 43.6% of eyes with unchanged vision, 3.6% losing 1 line, and 36.4% with a loss of ≥2 lines ($p = 0.401$).

In our study, qualified success was achieved in 53% of patients. This outcome concurs with Bolek et al, who reported a 64% qualified success rate but noted no patients achieved complete success at the 3-year follow-up visit, a finding similar to ours.[13] Longfang et al reported a 41.7% success rate at 1 year, while Torky et al observed a higher success rate of 77.4% with UCP as well as Almobarak et al who reported a 79.4 ± 6.9%.[14,15] Conversely, Basto et al reported a lower success rate of 27.3% for MP-CPC compared to 50.8% in our study.[16] These differences suggest that while both UCP and MP-CPC offer comparable IOP reduction, there may be differences in long-term success rates and visual outcomes, potentially necessitating repeat treatments to improve overall results.

Interestingly, in our cohort, only one eye experienced pain as a postoperative complication in the UCP group while the MP CPC group did not report any postoperative complication. This contrasts with the findings of Bolek et al, who reported a notable incidence of complications following UCP, including conjunctival hyperemia in 36 patients (58.1%), epithelial defect in two patients (3.2%), hypotony in three patients (4.8%), scleral mark in 43 patients (69.4%), pupil irregularity in 31 patients (54.2%), and macular edema in three patients (4.8%).[13] Longfang et al also documented postoperative complications after UCP, specifically conjunctival congestion (13 subjects), anterior chamber inflammation (10 subjects), scleral ring congestion (three subjects), and scleral imprint (three subjects). Notably, Longfang et al described scleral ring congestion and scleral imprint as relatively rare but long-lasting complications, observed even 12 months post-treatment, while our study did not observe these complications.[14] Almobarak at al also reported cataract development or progression in 8/26 phakic eyes (30.8%), with 6 of these eyes (23.1%) requiring subsequent cataract surgery. Additionally, they noted hypotony with choroidal detachment in 2 eyes (3.0%), prolonged or rebound anterior chamber reaction in 7 eyes (10.6%), and macular edema in 2 eyes (3.0%).[12]

Overall, these findings indicate that while both UCP and MP-CPC are effective for IOP reduction, they may differ in terms of visual outcomes and long-term success rates, and the potential complications associated with UCP, as reported in prior literature, warrant careful consideration when interpreting our own safety outcomes and counseling patients.

Further research with larger sample sizes and extended follow-up is needed to fully understand the long-term impacts of these treatments on IOP control and visual acuity, and to determine the best approaches for optimizing patient outcomes.

The retrospective nature of our study is a limitation. The loss of follow-up data for some patients introduces potential biases and limits the ability to draw definitive conclusions about long-term outcomes and efficacy. The absence of data on previous glaucoma surgeries, a potential influence on outcomes, is also recognized. These limitations underscore the need for further prospective, randomized controlled trials with larger cohorts to validate our findings and provide a more comprehensive comparison of these two treatments.

Conclusion

Both UCP and MP-CPC are safe and effective in reducing IOP in patients with refractory glaucoma, with similar reductions observed between the two techniques. Our study found that UCP had a comparable visual outcome and qualified success rate with MP-CPC. It also demonstrated the potential need for further treatments to improve patient outcome and long-term control of their disease.

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Disclosure

The authors report no conflicts of interest in this work.

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