Fovea-Friendly™
MicroPulse® Laser Therapy
MicroPulse = Increased Retinal Sensitivity without Damage

Prospective, Masked, Randomized Clinical Trial
- 62 eyes (50 patients)
- Untreated, center-involving CSME
- Randomized to mETDRS or 810 nm MicroPulse

1 Year Results
- MicroPulse was as effective as mETDRS in
  - stabilizing VA
  - reducing macular edema
- With added benefits of
  - no tissue damage detectable at any time point postoperatively
  - significant improvement in retinal sensitivity

1. Vujosevic S, Bottega E, Casciano M, Pilotto E, Convento E, Midena E. Retina 2010
MicroPulse Stimulates Biological Factors

Visible
Conventional CW (DRS/ETDRS) Tissue-sparing
MicroPulse

Modulation of the expression of intracellular biological factors

MicroPulse laser treatment, produces a stress response and induces beneficial intracellular biological factors that are primarily anti-angiogenic and restorative without tissue damage as seen in CW.


PEDF - plays a role in inhibiting neovascularization by its anti-angiogenic activity
TSP1 - one of the most potent anti-angiogenic factors
SDF1 - plays a key role in recruitment of bone marrow-derived reparative cells
β-actin - protein that is involved in cell motility, structure and integrity
Considerations for Incorporating MicroPulse

- **Safety**
  - Fovea-friendly, no tissue damage, repeatable
  - Absence of laser scars minimizes vision loss over time

- **Efficacy**
  - Demonstrated through clinical studies and practical experience, durable therapy

- **Efficiency**
  - Quick and easy treatment
  - Faster than conventional focal or grid laser

- **Economics**
  - Patient $↓
  - Healthcare System $↓
  - Expense to Practice $↓
  - Dual-laser Platform $↓
  - Practice Revenue $↑
• Long-term retrospective review: 274 consecutive eyes with macular edema due to DME or BRVO were treated with MicroPulse high density laser treatment using various duty cycles (DC) and followed for up to 10 years. 252 eyes met inclusion criteria.

• Results:
  Frequency of laser-induced retinal damage:
  • Eyes treated with 10-15% DC 8% (7/84)
  • Eyes treated with 5% DC 0% (0/168)

• 5% DC treated eyes showed no detectable retinal damage using infrared, red-free or FAF photos; FA, ICGA; or SD-OCT at 12 months
Both 810 nm and 577 nm subvisible MicroPulse laser with 5% duty cycle and fixed power parameters appear to be safe in center involving DME.

At 6 months, 60 eyes (43 patients) treated with 810 nm and 577 nm showed:

- No difference in macular volume
- No signs of inner or outer retinal and choroidal damage
- No changes shown on FAF or MP1
- No absolute scotoma
- Fixation was always central and stable in all patients

What is MicroPulse Technology?

MicroPulse technology finely controls thermal elevation by “chopping” a continuous-wave (CW) beam into an envelope of repetitive short pulses.
How Does MicroPulse Work?

Repetitive short pulses permit tissue to cool between pulses and reduce thermal buildup.
Low-intensity MicroPulse exposures avoid thermal retinal injury. Therefore, high-density (confluent) coverage of the diseased retina is needed to maximize clinical effectiveness of MicroPulse Laser Therapy.1-8

Evolution of Subthreshold Photocoagulation

Continuous-Wave, Conventional – DRS / ETDRS

Modified ETDRS

MicroPulse Invisible By Biomicroscopy

Illustrations compliments of Martin A. Mainster, PhD., MD, FRCOphth
Continuous-Wave Barely Visible Scanning

Fluid-like spikes adjacent to ruptured RPE (arrows) Immediately after CW and pattern scanning laser, a hyper-reflective band appeared at the laser sites.

IRIDEX MicroPulse

100% of tissue spared Retinal morphology did not change at any time during the observation period after MicroPulse.


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Subvisible CW Scanning ≠ MicroPulse

Subthreshold CW Laser
561 nm; 200 µm spot; 50 mW; 10 ms

Subthreshold CW Laser
532 nm; 200 µm spot; 50 mW; 30 ms

Photos compliments of Sam Mansour, MD
MicroPulse Clinical Results - Lavinsky

Comparison of mETDRS vs. Low Density vs. High Density Protocols for DME

- A prospective, double-masked, controlled clinical trial on 123 eyes with DME
- Compared three dosing protocols and followed patients for a minimum of 1 yr
- Results:

<table>
<thead>
<tr>
<th></th>
<th>Modified ETDRS</th>
<th>MicroPulse High Density</th>
<th>MicroPulse Low Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment Intensity</td>
<td>Mild</td>
<td>Low</td>
<td>Low</td>
</tr>
<tr>
<td>Treatment Density</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
</tr>
<tr>
<td>OCT-CMT (Δ)</td>
<td>-126 μm</td>
<td>-154 μm</td>
<td>-32 μm</td>
</tr>
<tr>
<td>BCVA (Δ letters)</td>
<td>+4</td>
<td>+12*</td>
<td>-1</td>
</tr>
<tr>
<td>Gain ≥15 letters</td>
<td>23%</td>
<td>48%*</td>
<td>5%</td>
</tr>
</tbody>
</table>

*Indicates significant improvement compared to mETDRS (P < 0.05)

Lavinsky D, Cardillo JA, Melo LA, Jr., Dare A, Farah ME, Belfort R Jr. Invest Ophthalmol Vis Sci 2011

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Confluent, High-Density Laser Patterns
For MicroPulse® Protocols

MicroPulse laser therapy has shown clinical success using confluent spacing.¹⁻²

TxCell™ Scanning Laser Delivery System offers confluent, high-density applications in a wide selection of patterns.

TxCell-Guided MicroPulse for Center-Involving ME due to BRVO

**Patient:** 79-year-old female with BRVO and AMD.

**Pre-MicroPulse:** VA 20/30  
Central retinal thickness 263 µm  
Extrafoveal thickness 321 µm  
Juxtafoveal thickness 352 µm

**15 Weeks Post-MicroPulse:** VA 20/25  
Central retinal thickness 259 µm  
Extrafoveal thickness 312 µm  
Juxtafoveal thickness 329 µm
**Patient:** 54-year-old male with history of bullous CSR and a large persistent neurosensory detachment for 10 months after initial presentation.

**Pre-MicroPulse:** VA 20/200  
CMT 640 µm

**4 mos Post-MicroPulse:** VA 20/25  
CMT 204 µm with complete resolution of subretinal fluid

TxCell-guided MicroPulse: three 7x7 treatment grids placed confluently over all areas of leakage or fluid, including in the fovea.

Read Case Report by Dr. Gennady Landa

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**Patient:** 79-year-old female with insulin-dependent diabetes mellitus and a history of nonproliferative diabetic retinopathy OU.

**Pre-MicroPulse:** VA 20/60  
CST 340 µm

**1 mo Post-MicroPulse:** VA 20/40*  
CST 280 µm  
*Baseline for patient

Read Case Report by Dr. Johnny Tang
**Patient:** 63-year-old male with very aggressive refractive DME that would not respond to anti-VEGF or steroid

**Pre-MicroPulse:** VA 20/200, CRT 438 µm

**3 Months Post-MicroPulse:** VA 20/60, CRT 270 µm

Read Case Report by Dr. Aaron Appiah
Patient: 64-year-old male with history of systemic hypertension

Pretreatment: VA 20/150, CRT 870 μm. Clinical exam revealed prominent cystoid macular edema.

6 weeks post third anti-VEGF treatment. Pre-MicroPulse: VA 20/70-2, CRT 584 μm. Recurrent macular edema noted.

Approximately 5 months Post-MicroPulse: VA 20/40+2, CRT 261 μm. No macular edema observed on clinical exam.

Read Case Report by Dr. Patrick Caskey
How would you treat these patients with good vision?

All patients have 20/20 to 20/40 VA.

- Intrafoveal cysts without retinal thickening.
- Intrafoveal thickening with minimal central foveal thickening.
- Isolated central foveal cyst.
- Diffuse macular thickening including the fovea.
Before
4 – 7 mos Post MicroPulse

Intrafoveal cysts without retinal thickening
Intrafoveal thickening with minimal central foveal thickening
Isolated central foveal cyst
Diffuse macular thickening including the fovea
Laser Still Plays a Critical Role in the Treatment of DME

In Protocol 1, patients with deferred* laser did best

(*deferred= waiting 6 months before treating with laser)

DRCR. Randomized Trial Evaluating Ranibizumab Plus Prompt or Deferred Laser or Triamcinolone Plus Prompt Laser for Diabetic Macular Edema Ophthalmology 2010; 117:1064-1077

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Considerations for Incorporating MicroPulse

Safety
- Fovea-friendly, no tissue damage, repeatable
- Absence of laser scars minimizes vision loss over time

Efficacy
- Demonstrated through clinical studies and practical experience, durable therapy

Efficiency
- Quick and easy treatment
- Faster than conventional focal or grid laser

Economics
- Patient $\downarrow$
- Healthcare System $\downarrow$
- Expense to Practice $\downarrow$
- Dual-laser Platform $\downarrow$
- Practice Revenue $\uparrow$
Repeatable MicroPulse® Laser Trabeculoplasty
MicroPulse® Laser Trabeculoplasty (MLT) for the Treatment of Glaucoma

Trabecular meshwork after ALT
Continuous-wave laser exposures can cause high thermal rise resulting in tissue damage

Trabecular meshwork after MLT
Meshwork remains intact without the signs of tissue damage while still as effective as ALT & SLT.¹

Evidence of Dose Response

The graph illustrates the percentage IOP reduction at different power levels: 300mW, 700mW, and 1000mW, over various time periods: 1 Month, 4 Months, 12 Months, and 24 Months.

- At 300mW, the IOP reduction is minimal and does not vary significantly over time.
- At 700mW, the IOP reduction increases with time, with the highest reduction at 24 Months.
- At 1000mW, the IOP reduction is the most pronounced, with significant reductions at 4 Months and further increases at 12 and 24 Months.

David Gossage, DO, FAOCO, FAAO, Gossage Eye Institute, Hillsdale, MI
Multi-Center 1000 mW MLT
Pre-op ≥ 21 mmHg

<table>
<thead>
<tr>
<th>Meds</th>
<th># of pts</th>
<th>1 month</th>
<th>3-4 months</th>
<th>6 months</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.0 → 2.8 (NS)</td>
<td>40</td>
<td>34</td>
<td>34</td>
<td>13</td>
<td>10</td>
</tr>
</tbody>
</table>

~ 6 mmHg drop
~ 25% IOP reduction

1 Year IOP Results

<table>
<thead>
<tr>
<th>IOP mm Hg</th>
<th>25.0</th>
<th>24.6%</th>
<th>18.4 ± 2.9</th>
<th>17.5 ± 2.9</th>
<th>17.5 ± 3.6</th>
<th>18.5 ± 0.9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td></td>
<td></td>
<td>24.4 ± 3.6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Meds | 3.0 | 2.8 (NS) |

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Ike Ahmed, MD, FRCSO, University of Toronto, Toronto, Canada
David Gossage, DO, FAOCO, FAAO, Gossage Eye Institute, Hillsdale, MI
Nathan Radcliffe, MD, Weill Cornell Medical College, New York, NY
Steven Vold, MD, Vold Vision, LLC Fayetteville, AR
Multi-Center 1000 mW MLT
Pre-op ≥ 18 mmHg

~ 4.5 mmHg drop
~ 20% IOP reduction

<table>
<thead>
<tr>
<th>Meds</th>
<th># of pts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9 → 2.3 (NS)</td>
<td>66</td>
</tr>
</tbody>
</table>

IOP mmHg

<table>
<thead>
<tr>
<th>Time</th>
<th>IOP mmHg</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>22.3 ± 3.8</td>
<td>20.6%</td>
</tr>
<tr>
<td>1 month</td>
<td>17.7 ± 3.0</td>
<td>22.4%</td>
</tr>
<tr>
<td>3-4 months</td>
<td>17.3 ± 2.7</td>
<td>24.7%</td>
</tr>
<tr>
<td>6 months</td>
<td>16.8 ± 3.2</td>
<td>20.2%</td>
</tr>
<tr>
<td>1 year</td>
<td>17.8 ± 1.4</td>
<td></td>
</tr>
</tbody>
</table>

Ike Ahmed, MD, FRCSC, University of Toronto, Toronto, Canada
David Gossage, DO, FAOCO, FAAO, Gossage Eye Institute, Hillsdale, MI
Nathan Radcliffe, MD, Weill Cornell Medical College, New York, NY
Steven Vold, MD, Vold Vision, LLC Fayetteville, AR

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## MLT / SLT Comparison

<table>
<thead>
<tr>
<th>Parameter</th>
<th>MicroPulse® Laser Trabeculoplasty (MLT)</th>
<th>Selective Laser Trabeculoplasty (SLT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wavelength</td>
<td>532 nm and 577 nm</td>
<td>532 nm</td>
</tr>
<tr>
<td>Mechanism</td>
<td>Thermally effects - not destroys - pigmented trabecular meshwork cells without thermal or collateral damage</td>
<td>Selective destruction of pigmented trabecular meshwork cells without thermal or collateral damage</td>
</tr>
<tr>
<td>Learning Curve</td>
<td>Easy</td>
<td>Easy</td>
</tr>
<tr>
<td>Repeatable</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Visible signs of treatment intra-or post-operative</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Inflammation</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Spot Size</td>
<td>300 µm (smaller spot to access narrow angles)</td>
<td>400 µm</td>
</tr>
<tr>
<td>Complications</td>
<td>Minimal to none</td>
<td>Post-op IOP spikes are possible</td>
</tr>
<tr>
<td>Functionality of laser system</td>
<td>Continuous-wave and MicroPulse treatment for glaucoma and retinal disorders</td>
<td>SLT</td>
</tr>
<tr>
<td>Parameter Control</td>
<td>Power, ON/OFF time, number and rep rate of pulses</td>
<td>Pulse energy</td>
</tr>
</tbody>
</table>


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MLT / SLT Comparison

Micropulse Laser Trabeculoplasty After Previous Laser Trabeculoplasty

BY TAK YEE TANIA TAI, MD

CASE PRESENTATION
A 57-year-old man was referred to me for advanced primary open-angle glaucoma. The patient’s visual acuity was 20/25 in the right eye and count fingers at 3 feet in the left eye. He had mild exotropia in both eyes. A Humphrey 10-2 visual field test (Carl Zeiss Meditec) showed severe constriction that was greater in the left eye. Advanced cupping of the optic disc was present in both eyes, and the IOP was 28 mm Hg in each eye (Figures 1 and 2).

The patient noted that he had been using timolol, brimonidine (Combigan, Allergan) and travoprost (Travatan, Alcon) in both eyes for an extended period of time. Considering the advanced nerve damage, I felt the IOP needed to be lowered further. The patient lived in Jamaica and traveled frequently, so I first attempted to maximize his medical regimen as much as possible. I started him on methazolamide 10 mg once daily (he was unable to tolerate more frequent dosing), but the IOP in both eyes remained in the high teens.

In February 2013, I performed selective laser trabeculoplasty (SLT) on the patient’s left eye. I treated 27 spots with 25 spots, ranging from 0.5 to 0.7 mm per spot. I decided against a 360° SLT treatment due to the potentially higher risk of an IOP spike after the procedure with a greater area of laser application. The patient responded well and the IOP decreased to 13 mm Hg in the left eye. I treated the right eye with the same protocol in April 2013, after which the IOP in both eyes measured between 12 and 13 mm Hg. Because of the patient’s advanced optic nerve damage,

Patient’s IOP dropped from 19 to 13 mm Hg and stable for 6 months

“For patients such as this one, with advanced disease and IOP spikes and for whom pharmaceutical treatments and previous laser treatments have failed, MLT is a viable option”

Case Report
- Patient IOP rebound post SLT
- Physician concern with SLT repeat treatment because of potential IOP spikes
- MLT performed because no history of inflammation post treatment
- Patient’s IOP dropped from 19 to 13 mm Hg and stable for 6 months

Read Case Report by Dr. Tania Tai

Tai, Glaucoma Today November/December 2014
MicroPulse Technology available in Multi-Functional Laser Systems

- Fovea-friendly™ MicroPulse* Laser Therapy¹ for retinal disorders
- Repeatable MicroPulse Laser Trabeculoplasty for glaucoma therapy
- Conventional photocoagulation
- TxCell™ Scanning Laser Delivery Device*: Multi-spot pattern scanning for efficient retinal photocoagulation
- FDA and CE clearance for both conventional and MicroPulse Laser Therapies

*MicroPulse and TxCell are optional with the IQ 577 and IQ 532 lasers

New Standard of Care

Tradewinds
Traditional laser burns
Ease of injections

Tradewinds
Increased patient pop.
Favorable economics

CW Laser
MicroPulse Laser
Pharma