Non-Damaging Retinal Laser Strategies: Barely Visible and Sub-Threshold Laser and Targeted Retinal Photocoagulation

P. E. Stanga
Consultant Ophthalmologist and Vitreoretinal Surgeon
Professor of Ophthalmology and Retinal Regeneration
Director, Manchester Vision Regeneration (MVR) Lab

Manchester Royal Eye Hospital, NIHR/Wellcome Trust Manchester CRF & University of Manchester
• Allergan Plc.
• Bausch & Lomb Inc.
  • Bayer AG
  • ExcelLens Inc.
  • Novartis AG
  • Optos Plc.
• Second Sight Medical Products, Inc.
  • Thrombogenics Inc.
  • Topcon Corp.
Do we know how laser works?

The exact mechanism of action of laser treatment is still debated

**PRP**

1. **Reduction of ischaemia** and production of angiogenic factors by ablating retinal cells, thus **lowering the metabolic load**

2. The improvement in oxygenation and metabolic transport between choroid and retina by **creating photoreceptors-free glial windows** and stimulation of RPE and choroidal cells

**MACULAR LASER**

The **healing response of the RPE to thermal injuries** activates a cellular cascade, resulting in the therapeutic effects

Unlike Injections...

Laser is too dependent on the “Operator”

Re-Define “what needs to be treated”

Need “Doses” and “Patterns”...

...that will suit most clinical scenarios

Remove the “Black Art” factor

Laser may reduce number of injections
Laser therapy in 2014-15

- SAFE PROCEDURE
- SINGLE SESSION AND PAINLESS
- EASY TO MAP TREATED AREAS, TITRATE LASER & TARGET RPE
- MINIMAL COLLATERAL DAMAGE WITH TISSUE HEALING RESPONSE
- REDUCED SIDE EFFECTS
- EFFECTIVE TREATMENT
- RESULTS INDEPENDENT OF "OPERATOR"
The restoration of normal retinal structure and responses would demonstrate the existence of constructive adult mammalian retinal plasticity after injury.

- Patches of photoreceptors in the rabbit retina were destroyed by selective laser photocoagulation, leaving retinal inner neurons (bipolar, amacrine, horizontal, ganglion cells) intact.

- Photoreceptors located outside of the damaged zone migrated to make new functional connections with deafferented bipolar cells located inside the lesion.
How can we titrate a lesion without a visible endpoint?

- Histology in these lesions demonstrated some selective damage to the RPE and photoreceptors.

- With 30% to 50% lesions were invisible with in vivo multimodal imaging, and damage was limited to RPE.

- Over the time, photoreceptors shifted into the coagulated zone, re-establishing normal retinal anatomy in lesion.
EpM® allows the physician to more easily and consistently operate within the sub-visible range.

Invisible burns: the biggest risk is lack of therapeutic effect.
**Barely-Visible and Subthreshold 577nm (Yellow) Pascal® Laser with and without Endpoint Management® in Proliferative Diabetic Retinopathy and Diabetic Macular Oedema**

M Gil-Martinez 1,2, S Pastor-Irdoate 1,2, C Quijano 1,2, K Yau 1,2, Y D’Souza 1, S Mahmood 1, S Charles 1, G Turner 1, D Henson 1,2, D McLeod 1,2,3, PE Stanga 1,2,3

1Manchester Royal Eye Hospital, UK
2Manchester Vision Regeneration (MVR) Lab at NHRI/Wellcome Trust Manchester CBF, UK
3Manchester Academic Health Science Centre and Centre for Ophthalmology and Vision Research, Institute of Human Development, University of Manchester, UK

**Purpose:**
To report on safe and effective laser treatment parameters for 577nm Pascal® Laser (YL:PL) with and without Endpoint Management® (PHD) in patients with Proliferative Diabetic Retinopathy (PDR) and/or Diabetic Macular Oedema (DME) and evaluate if this new treatment modality brings any changes in additional choroidal thickness (SCT).

**Methods:**
Retrospective observational case series of 61 YL:PL procedures in 59 patients. 20 females (66%) and 21 males (45%). Patients were categorized into three treatment groups: Single-session Photocoagulation (OS:OS), if full or partial Macular Grid (M3G), Single-session Photocoagulation (OS:OS), 3-Session Photocoagulation with Subthreshold (OS:OS) and M3G-PRP. Treatment was performed on patients with laser Irvine Fontana-Del Rio Irradiance Photocoagulator (FDOCT, 30 OCT 2000 FA plus Topcon Corp, Japan) post macular laser (OS:OS, 3-Session Photocoagulation). Eyes with PDR were diagnosed with vitreous, diabetic retinopathy (PDR) or non-proliferative diabetic retinopathy (NPDR). 16 eyes with macular oedema underwent subthreshold YL:PL using 0.35 mW/cm² in a grid pattern and 5 eyes underwent barely-visible photocoagulation. SCT was measured in these eyes using the new Spectralis OCT Choroidal Thickness software (Spectralis OCT. (OS:OS), Topcon Corp, Japan) before and immediately after treatment.

**Results (Table 1):**
- Group 1 (OS:OS): a mean of 1.89 ± 0.29 mm, 20 mm duration, 267 ± 2.95 mm energy, 1.8 mm spot size and 0.25 ± 0.25 mm spacing were applied.
- Group 2 (OS:OS): a mean of 1.93 ± 0.26 mm, 17 mm duration, 148 ± 1.48 mm energy, 3.0 mm spot size and 0.75 ± 0.25 mm were applied.
- Group 3 (OS:OS): a mean of 1.90 ± 0.24 mm, 17 mm duration, 148 ± 1.48 mm energy, 3.0 mm spot size and 0.75 ± 0.25 mm were applied.

**Conclusions:**
- Laser treatment parameters differ to those suggested by the Early Treatment Diabetic Retinopathy Study (ETDRS), making them unsuitable for use with barely-visible and subthreshold retinal laser strategies. This is the first Study to report on such high treatments in PDR and DME.

**Proposed new treatment strategy when using Barely-Visible and Subthreshold laser**

1. **Endpoint Management®** has the potential to significantly reduce choroidal oedema, while also allowing a focused and targeted therapeutic response.

2. **When treating with YL:PL Laser with (PHD) -**
   - Laser settings may be determined before treatment, based on pre-treatment OCT measurements in the patient.
   - Controlled by the operator, providing a customized treatment for each patient.

3. **Metabolic Control of Diabetic Retinopathy remains essential**

Gil-Martinez M; Pastor-Irdoate S; Quijano C; Yau K; D’Souza Y; Mahmood S; Charles S; Turner G; Henson D; McLeod D; Stanga PE. Barely-visible and Subthreshold 577 nm (Yellow) Pascal Laser® with and without Endpoint Management® in Proliferative Diabetic Retinopathy and Diabetic Macular Edema. ARVO 2014 Orlando. Session number: 548. Posterboard number: 6354-C0131
Barely visible and subthreshold 577 nm (yellow) Pascal® Laser with and without Endpoint Management®: Feasibility and Safety Audit

<table>
<thead>
<tr>
<th>MG Laser Parameters</th>
<th>Green Laser</th>
<th>Yellow Laser</th>
<th>PDR Laser Parameters</th>
<th>Green Laser</th>
<th>Yellow Laser</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pascal no Burns (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Mean (99)</td>
<td>159 ± (99)</td>
<td>184.39 ± (168.17)</td>
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<tr>
<td>Pascal Power (mW) mean (SD)</td>
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<tr>
<td>Mean (36.5)</td>
<td>133.5 ± (36.5)</td>
<td>148.18 ± (48.61)</td>
<td></td>
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<tr>
<td>EpM</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spot size “on air”</td>
<td>100 µ</td>
<td>100 µ</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>20 msec</td>
<td>10 msec</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space</td>
<td>1</td>
<td>0.75-1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Burn number</td>
<td>Higher number of burns are needed</td>
<td>0.75 spacing in between burns</td>
<td></td>
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<td></td>
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<tr>
<td>EpM</td>
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</tr>
<tr>
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<td>200</td>
<td>100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulse duration</td>
<td>30 msec</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Space</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
PRP: 2754 burns X1 spacing EpM® 40% 375 mW

MACULAR GRID: 698 burns X1 spacing EpM® 40% 200 mW

Before Laser treatment

1 month after treatment

After Laser treatment
CASE 2

258 burns
175 mW Power
Epm 65%
100 microns spot size
1.0 space 1 burn with apart

AFTER 2 MONTHS OF LASER TREATMENT
CASE 3

Spot number: 587, Spot size: 100 microns, Time 10 msec, Power 175mW with EpM 40%
We all know the different studies of pharmacological therapies versus laser in DMO.

However, we do not know how consistent the adherence to a laser protocol was.

Was there variability in spot endpoint, spot spacing, total dose, etc?
The RESTORE Study

Ranibizumab Monotherapy or Combined with Laser versus Laser Monotherapy for Diabetic Macular Edema

Active Comparator: Laser

Laser photocoagulation treatment was administered on Day 1 and at intervals of at least 3 months, if deemed necessary by the physician. Patients also received monthly sham intravitreal injection in the study eye for 3 consecutive months. After the third injection, treatment was suspended if either one of the following criteria was met: improvement in best corrected visual acuity (BCVA) could not be attributed to treatment at the last 2 visits, in the opinion of the investigator, or BCVA > 84 letters (approximately Snellen equivalent of 20/20) was observed at the last 2 visits. Active/sham laser treatment was always administered before (sham) intravitreal injections. The minimum interval between the 2 treatments was 30 minutes. In the extension study at the investigator's discretion, patients received open-label ranibizumab 0.5 mg intravitreal injections once a month until stable vision was reached (a maximum of 24 injections) and could receive laser therapy.

Interventions:
- Drug: Ranibizumab
- Procedure: Laser
- Drug: Sham to ranibizumab

Laser/Sham Laser Treatment. The first laser treatment (active or sham depending on treatment group; the ranibizumab + sham laser group did not receive active laser treatment) was administered on Day 1. If required, the first laser administration could be split into 2 sessions, 4 weeks apart. Retreatments were given in accordance with ETDRS guidelines at intervals no shorter than 3 months from the previous treatment if deemed necessary by the evaluating investigator. Patients receiving retreatment with active or sham laser continued to be treated with monthly ranibizumab or sham injections as long as the treatment criteria for intravitreal injection were fulfilled. Decisions on retreatment with laser/sham were independent of decisions to administer ranibizumab/sham injections and vice versa. Sham laser was applied under the same procedure used for laser treatment but without switching on the laser beam, and by imitating depression of the laser pedal.
3.2 Photocoagulation Technique

The laser treatment ‘session’ should generally be completed in a single ‘sitting’. The photocoagulation treatment technique, as described below, is a modification of the ETDRS technique and is the treatment approach that is commonly used in clinical practice. Use of fluorescein angiography to direct the treatment is at the discretion of the investigator. The initial photocoagulation treatment (first photocoagulation session following randomization) will be based on the macular appearance at the time of treatment (i.e., not based on the baseline appearance). Subsequent laser treatment following an injection, if needed, will be based on the pre-injection macular appearance.

<table>
<thead>
<tr>
<th>Burn Characteristic</th>
<th>Focal Photocoagulation (Modified-ETDRS technique)</th>
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<td>Direct Treatment</td>
<td>Directly treat all leaking microaneurysms in areas of retinal thickening between 500 and 3000 microns from the center of the macula (although may treat between 300 and 500 microns of macula if center-involved edema persists after initial focal photocoagulation, but generally not if the visual acuity is better than 20/40)</td>
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<td>Change in MA Color with Direct Treatment</td>
<td>Not required, but at least a mild gray-white burn should be evident beneath all microaneurysms</td>
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<td>Burn Size for Direct Treatment</td>
<td>50 microns</td>
</tr>
<tr>
<td>Burn Duration for Direct Treatment</td>
<td>0.05 to 0.1 sec</td>
</tr>
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</table>
A Prospective Randomized Trial of Intravitreal Bevacizumab or Laser Therapy in the Management of Diabetic Macular Edema (BOLT Study)

Follow-up Visits

Laser Arm. All patients in the laser arm underwent modified ETDRS MLT at their baseline visit or within 7 days of randomization. Subjects were subsequently reviewed every 4 months (16 weeks, 32 weeks, and 48 weeks), with an end of year 1 visit at 52 weeks. Retreatment (16-, 32-, and 48-week time points) was performed if clinically indicated by ETDRS guidelines. Modified ETDRS MLT comprised 50 μm argon laser spot size, laser applied only greater than 500 μm from the edge of the FAZ, with focal treatment aiming to cause mild Blanching of the retinal pigment epithelium and not darkening/whitening of microaneurysms. Areas of diffuse leakage or nonperfusion were similarly treated in a grid pattern. At each visit, a full history was taken and a complete ocular examination was performed (including IOP and dilated fundoscopy); BP was measured; ETDRS BCVA was recorded by an optometrist; and 7-field color fundus photography, FFA, and OCT (CMT and RNFL) were undertaken. In addition, HbA1c and an ECG were recorded at the 52-week visit.
A randomized trial to assess functional and structural effects of ranibizumab versus laser in diabetic macular edema (the LUCIDATE study).

Comm G¹, Kuprasad S², Pati T³, Neveu MM⁴, Holder GE⁴, Xing W⁵, Bunce C⁶, Patel P⁷, Egan C⁸, Rainbridge JW³, Hvin PG⁹.

Author information

Abstract

PURPOSE: To compare the functional and structural effects of ranibizumab versus macular laser therapy in patients with center-involving diabetic macular edema.

DESIGN: Prospective, randomized, single-masked clinical trial.

METHODS: Setting: Single center. Study Population: Thirty-three eyes of 33 patients with center-involving diabetic macular edema, with best corrected visual acuity of 55 to 79 Early Treatment Diabetic Retinopathy Study letters at baseline, completing the 48-week study period. Intervention: Subjects were randomized 2:1 to 3 loading doses of ranibizumab then retreatment every 4 weeks as required, or macular laser therapy at baseline, repeated as required every 12 weeks. Exploratory Outcome Measures: Structural imaging studies included greatest linear dimension and area of foveal avascular zone, perifoveal capillary dropout grade, and presence of morphologic features of diabetic macular edema on Spectralis optical coherence tomography (Heidelberg Engineering GmbH, Heidelberg, Germany). Functional measures: Visual acuity, retinal sensitivity in the central 4 and 12 degrees on microperimetry, color contrast sensitivity proton and tritan thresholds, pattern and full-field electroretinogram amplitudes and implicit times, and multifocal electroretinogram amplitude distribution. These were reported at 12, 24, and 48 weeks.

RESULTS: Ranibizumab-treated subjects gained 6.0 vs 0.9 letters lost for laser, demonstrated improved tritan and proton color contrast thresholds, and improved retinal sensitivity: Electrophysiologic function also improved after ranibizumab therapy. No safety issues were evident. Better retinal sensitivity outcomes were associated with anatomic factors of Fovea and its immediate surround.

CONCLUSIONS: Ranibizumab therapy in the treatment of diabetic macular edema seems to improve retinal function and structure as demonstrated by this evaluation of different assessment methods.
Two-year outcomes of the ranibizumab for edema of the macula in diabetes (READ-2) study.


Author information


Abstract

OBJECTIVES: To determine the long-term effects of ranibizumab (RBZ) in patients with diabetic macular edema (DME).

DESIGN: Prospective, randomized, interventional, multicenter clinical trial.

PARTICIPANTS: One hundred twenty-six patients with DME.

METHODS: Subjects were randomized 1:1:1 to receive 0.5 mg RBZ at baseline and months 1, 3, and 5 (group 1), focal or grid laser photocoagulation at baseline and month 3 if needed (group 2), or a combination of 0.5 mg RBZ and focal or grid laser at baseline and month 3 (group 3). Starting at month 6, if retreatment criteria were met, all subjects could be treated with RBZ.

MAIN OUTCOME MEASURE: The mean change from baseline in best-corrected visual acuity (BCVA) at month 24.

RESULTS: After the primary end point at month 6, most patients in all groups were treated only with RBZ, and the mean number of injections was 5.3, 4.4, and 2.9 during the 16-month follow-up period in groups 1, 2, and 3, respectively. For the 33 patients in group 1, 34 patients in group 2, and 34 patients in group 3 who remained in the study through 24 months, the mean improvement in BCVA was 7.4, 0.5, and 3.8 letters at the 6-month primary end point, compared with 7.7, 5.1, and 6.8 letters at month 24, and the percentage of patients who gained 3 lines or more of BCVA was 21, 0, and 6 at month 6, compared with 24, 18, and 26 at month 24. The percentage of patients with 20/40 or better Snellen equivalent at month 24 was 45% in group 1, 44% in group 2, and 35% in group 3. Mean foveal thickness (FTH), defined as center subfield thickness, at month 24 was 340 μm, 286 μm, and 258 μm for groups 1, 2, and 3, respectively, and the percentage of patients with center subfield thickness of 250 μm or less was 36%, 47%, and 68%, respectively.

CONCLUSIONS: Intravitreal injections of RBZ provided benefit for patients with DME for at least 2 years, and when combined with focal or grid laser treatments, the amount of residual edema was reduced, as were the frequency of injections needed to control edema.

FINANCIAL DISCLOSURE(S): Proprietary or commercial disclosure may be found after the references.

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Diabetic Retinopathy Clinical Research Network

Prompt Panretinal Photocoagulation versus Intravitreal Ranibizumab with Deferred Panretinal Photocoagulation for Proliferative Diabetic Retinopathy

Version 1.0

October 6, 2011

4.7 Focal/Grid Photocoagulation Technique

If focal/grid photocoagulation is warranted, the laser treatment ‘session’ should generally be completed in a single ‘sitting’. The photocoagulation treatment technique, as described below, is a modification of the ETDRS technique and is the treatment approach that is commonly used in clinical practice. Use of fluorescein angiography to direct the treatment is at the discretion of the investigator. Laser treatment following an injection, if needed, will be based on the pre-injection macular appearance.

<table>
<thead>
<tr>
<th>Burn Characteristic</th>
<th>Focal/Grid Photocoagulation (non-PASCAL guidelines)² (DRCR.net focal/grid laser technique)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Treatment</td>
<td>Directly treat all leaking microaneurysms in areas of retinal thickening between 500 and 3000 microns from the center of the macula (although may treat between 300 and 500 microns of macula if central-involved edema persists after initial focal photocoagulation, but generally not if the visual acuity is better than 20/40).</td>
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<tr>
<td>Change in MA Color</td>
<td>Not required, but at least a mild gray-white burn should be evident beneath all microaneurysms</td>
</tr>
<tr>
<td>with Direct Treatment</td>
<td></td>
</tr>
<tr>
<td>Spot Size for Direct Treatment</td>
<td>50 microns</td>
</tr>
<tr>
<td>Burn Duration for Direct Treatment</td>
<td>0.05 to 0.1 sec</td>
</tr>
<tr>
<td>Grid Treatment</td>
<td>Applied to all areas with edema not associated with microaneurysms. If fluorescein angiography is obtained, grid is applied to areas of edema with angiographic nonperfusion when judged indicated by the investigator.</td>
</tr>
<tr>
<td>Area Considered for Grid Treatment</td>
<td>500 to 3000 microns superiorly, nasally and inferiorly from center of macula 500 to 3500 microns temporally from macular center No burns placed within 500 microns of disc</td>
</tr>
<tr>
<td>Burn Size for Grid Treatment</td>
<td>50 microns</td>
</tr>
<tr>
<td>Burn Duration for Grid Treatment</td>
<td>0.05 to 0.1 sec</td>
</tr>
</tbody>
</table>
## Table 1

<table>
<thead>
<tr>
<th>Burn Characteristic</th>
<th>Direct/Grid Photocoagulation (Modified-ETDRS technique)</th>
<th>Mild Macular Grid Photocoagulation Technique</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct Treatment</td>
<td>Directly treat all leaking microaneurysms in areas of retinal thickening between 500 and 3000 microns from the centre of the macula (but not within 500 microns of disc)</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Change in MA Color with Direct Treatment</td>
<td>Net required, but at least a mild gray-white burn should be evident beneath all microaneurysms</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Burn Size for Direct Treatment</td>
<td>50 microns</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Burn Duration for Direct Treatment</td>
<td>0.05 to 0.1 sec</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Grid Treatment</td>
<td>Applied to all areas with diffuse leakage or neovascularisation within area described below for treatment</td>
<td>Applied to entire area described below for treatment (including uninvolved retina)</td>
</tr>
<tr>
<td>Area Considered for Grid Treatment</td>
<td>500 to 3000 microns superiorly, nasally and inferiorly from centre of macula 500 to 3500 microns temporally from macular centre</td>
<td>500 to 3000 microns superiorly, nasally and inferiorly from centre of macula 500 to 3500 microns temporally from macular centre</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Burn Duration for Grid Treatment</td>
<td>0.05 to 0.1 sec</td>
<td>0.05 to 0.1 sec</td>
</tr>
<tr>
<td>Burn Intensity for Grid Treatment</td>
<td>Barely visible (light grey)</td>
<td>Barely visible (light grey)</td>
</tr>
<tr>
<td>Burn Separation for Grid Treatment</td>
<td>2 visible burn widths apart</td>
<td>200 to 300 total burns evenly distributed over the treatment area outlined above (approx. 2 to 3 burn widths apart)</td>
</tr>
<tr>
<td>Wavelength (Grid and Focal Treatment)</td>
<td>Green to yellow wavelengths</td>
<td>Green to yellow wavelengths</td>
</tr>
</tbody>
</table>
What have we learned?

Higher number of burns
Close to the fovea
0.75 in between burns

- Treat all areas of thickening
- Metabolic control is essential

Subthreshold laser needs to be repeated, like injections, as the REP heals!
TARGETED RETINAL PHOTOCOAGULATION
What do we mean by Targeted Retinal Photocoagulation (TRP)?

TRP is NOT treating only the peripheral retina...

TRP means treating areas of retinal non-perfusion and the transition zone while sparing better-perfused tissue from laser-induced tissue scarring.

The transition zone or Ischaemic Penumbra is the critically hypoxic tissue characterised by Hypoxia-inducible factor-1 (HIF-1) upregulation and secretion of angiogenic proteins such as Vascular Endothelial Growth Factor (VEGF)


RP applied to the entire of area ischaemic/hypoxic retina significantly inhibits NV.

The advent of Wide-Field Imaging and hence improved means of identifying retinal non-perfusion and penumbra have made TRP a reality.

WF-FFA is essential to assess mid and peripheral retinal perfusion.
If ischaemia and penumbra reach the posterior pole:

TRP will look similar to “standard PRP”
✓ Blankenship first devised a peripheral laser strategy to spare the posterior retina from PRP

✓ In order to reduce the risks of complications after PRP whilst maintaining clinical efficacy the optimal regime may be to “target” the laser treatment
Pilot randomised clinical trial of Pascal TargETEd Retinal versus variable fluence PANretinal 20 ms laser in diabetic retinopathy: PETER PAN study.

Muqit MM, Young LB, McKenzie R, John B, Marcellino GR, Henson DB, Turner GS, Stanga PE.
Manchester Royal Eye Hospital, Manchester, UK.

PDR Response (2,500 burns)

Clinical Outcomes: Inter-grader agreement was substantial (kappa=0.76)

TRP achieves at 12 weeks

1. Regression of NV comparable to PRP
2. Reduction of ACRT
3. No visual loss
4. Improved Visual Fields

TRP:
60% partial regression
10% complete regression
30% no change

MT-PRP:
50% partial regression
20% complete regression
20% no change

SI-PRP:
70% partial regression
20% complete regression
10% worse

No comparable differences of clinical effects between groups
DRS showed that 10% of patients suffered a decline in visual acuity and 5% developed a constriction of their visual fields.

DRS and ETDRS revealed that full scatter photocoagulation may exacerbate macular oedema and lead to visual loss.

Regression of new vessels comparable to that obtained with PRP.

No visual field reduction.

Less inflammation/CMO.

Fast procedure.

TRP was not possible with the Retinal Imaging technology available at the time of DRS and ETDRS.

Additional areas can always be subsequently treated in case of lack of initial response !!!!!
- Need of multiple treatments over time, and possibly from a young age, carries cumulative risk of side effects
- Therefore the need of minimal treatment to stabilise the condition with every recurrence
- Laser applied to perfused retina will have no effect on hypoxia-induced neovascularisation (since this is not VEGF-secreting tissue)
- However, the eye will be exposed to the potential complications of laser
- TRP offers acceptable rates of disease regression with reduced loss of central visual function and peripheral visual field
- Single-Session TRP should be considered as the treatment technique for the first laser session
- If retinal ischaemia and penumbra extend up to vascular arcades: TRP=PRP
- If you are considering combining laser with anti-VEGF: TRP makes more sense than PRP, as TRP spares perfused retina
- Of course we can be successful with PRP, however, at what functional cost?!?
- Patients were going blind before DRS and ETDRS. However, we need to continue reducing the side effects of laser
- Perhaps more follow ups will be required with TRP but it may be time to take advantage of the progress achieved in Imaging as well as laser technologies since the DRS and ETDRS reported their results almost two decades ago
- DR is a progressive condition and TRP may need to be repeated. However, as with TRP we are only treating pathological tissue with every relapse of the disease, we may be delaying functional loss even from cumulative TRP laser sessions

**Do not overtreat at 1st session with PRP:**
perform TRP and retreat later in case of lack of initial response
State-of-the-Art Laser in 2014 & in 1 slide:

We no longer need to burn the full thickness of the retina

We need to treat earlier: Macula & TRP or PRP

Single Session TRP or PRP

Macula and TRP or PRP during same laser session

More burns/Less spacing when using Barely Visible/Sub-Threshold Laser

Treat all areas of retinal thickening and up to the fovea: EpM®

Consider TRP as per WF-FFA

AF to map previous or current laser treatment
With thanks to:

- **Manchester Vision Regeneration (MVR) Lab at NIHR/Wellcome Trust CRF**

**Director**

Prof Paulo Stanga

**Clinical Research Retina Fellows:**

- Dr Maria Gil Martinez
- Dr Salvador Pastor Idoate
- Dr Claudia Quijano

and

- Miss Yvonne D’Souza
- Mr Steve Charles
- Mr George Turner
- Mr Saj Mahmood
- Mr Konstantinos Balaskas
- Prof Paul Bishop
- Prof David Henson
- Prof David McLeod

**Danielle Ridyard MA**

Research Administrator

Eye Hospital Research Office

Manchester Royal Eye Hospital

Central Manchester University Hospitals NHS Foundation Trust Oxford Road

Manchester M13 9WL

Tel: 0161 701 7691

danielle.ridyard@cmft.nhs.uk