



INTERNATIONAL
COUNCIL *of*
OPHTHALMOLOGY

ICO Guidelines for Diabetic Eye Care



ICO Guidelines for Diabetic Eye Care

The International Council of Ophthalmology (ICO) developed the *ICO Guidelines for Diabetic Eye Care* to serve a supportive and educational role for ophthalmologists worldwide. They are intended to improve the quality of eye care for patients.

The *Guidelines* are for the screening of diabetics, and to assess and treat people with diabetic retinopathy and other ocular complications of diabetes. They address the needs and requirements for the following levels of service:

- Essential or core: for low resources, or resource-poor settings
- Mid-Level: for some resources, or intermediate-resource settings
- Current state-of-the-art: for abundant resources, or resource-rich settings.

The *Guidelines* are designed to inform ophthalmologists about the requirements for the screening and detection of diabetic retinopathy, and the appropriate assessment and management of patients with diabetic retinopathy. The *Guidelines* also demonstrate the need for ophthalmologists to work with primary care providers and diabetologists.

With diabetes and diabetic retinopathy a rapidly increasing problem worldwide, it is vital to ensure that ophthalmologists are properly prepared.

The ICO believes an ethical approach is indispensable, as it is the first step toward quality clinical practices. Download the *ICO Code of Ethics* at: www.icoph.org/downloads/icoethicalcode.pdf (PDF – 198 KB).

The *Guidelines* are designed to be a working document and will be updated on an ongoing basis. This document was developed and printed in November 2013.

We hope you will find these *Guidelines* easy to read, translate, and adapt for local use. We welcome any feedback, comments, or suggestions. Please email us at: info@icoph.org.

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I. Introduction

Diabetes mellitus (DM) is a global epidemic with significant morbidity. Diabetic retinopathy (DR) is the specific microvascular complication of DM and affects 1 in 3 persons with DM. DR remains the leading cause of vision loss in working adult populations. Patients with severe levels of DR are reported to have poorer quality of life and reduced levels of physical, emotional, and social well-being, and they utilize more health care resources.

Epidemiological studies and clinical trials have shown that optimal control of blood glucose, blood pressure, and blood lipids can reduce the risk of developing retinopathy and slow its progression. Timely treatment with laser photocoagulation, and increasingly, the appropriate use of intraocular administration of vascular endothelial growth factor (VEGF) inhibitors can prevent visual loss in vision-threatening retinopathy, particularly diabetic macular edema (DME). Since visual loss may not be present in the earlier stages of retinopathy, regular screening of persons with diabetes is essential to enable early intervention.

Epidemiology of Diabetic Retinopathy

In many countries, DR is the most frequent cause of preventable blindness in working-aged adults. In the United States, an estimated 40% (8% for vision-threatening retinopathy) of persons with type 2 diabetes and 86% (42% for vision-threatening retinopathy) of persons with type 1 diabetes have DR. High prevalence estimates have also been reported in other countries. Despite concern about a potential diabetes epidemic in Asia, epidemiologic data for DR in Asian countries is relatively limited. In Latin America, 40% of diabetic patients had some DR and 17% required treatment. Few studies of DR have been conducted in Africa.

DR develops with time and is associated with poor control of blood sugar, blood pressure, and blood lipids. The longer someone has had DM, and the poorer their control, the higher their risk of developing DR. Good control reduces the annual incidence of developing DR and extends life. However, good control does not necessarily reduce the lifetime risk of developing DR, so everyone with DM is at risk.

The overall prevalence of DR in a community is also influenced by the number of people diagnosed with early DM:

- In areas with good health care systems, more people with early DM will have been diagnosed. The prevalence of DR in people with newly diagnosed DM will be low, resulting in a lower overall prevalence of DR.
- In areas with poorer health care systems, fewer people with early DM will have been diagnosed. The prevalence of DR in people with newly diagnosed DM will be high, resulting in a somewhat higher overall prevalence of DR.

In general, it can be assumed that approximately one third of those with DM will have DR, and approximately one third of those—or about 10%—will have sight-threatening DR that requires treatment.

Classification of Diabetic Retinopathy

The classic retinal microvascular signs of DR include microaneurysms, hemorrhages, hard exudates (lipid deposits), cotton-wool spots (ischemic retina related to accumulations of axoplasmic debris within adjacent bundles of ganglion cell axons⁸⁶), venous dilation and beading, and intraretinal microvascular abnormalities (i.e., dilated pre-existing capillaries). (**Photos in Annex**)

Nonproliferative Diabetic Retinopathy

Nonproliferative DR is the early stage of DR. Recognition of nonproliferative retinopathy allows a prediction of risk of progression, visual loss, and determination of a review interval. **Annex Table 1** shows the signs of nonproliferative DR.

Proliferative Diabetic Retinopathy

Proliferative diabetic retinopathy (PDR) is a severe stage of DR and represents an angiogenic response of the retina to extensive ischemia and capillary closure. Neovascularization has been divided into 2 groups: new vessels on the disc (NVD) and new vessels elsewhere (NVE). Typically NVE grow at the interface of perfused and nonperfused retina. **Annex Table 2** shows the signs of proliferative DR.

The stages of DR, from nonproliferative to proliferative DR, can be classified using the simple international classification of DR scale shown in **Table 1**. DME is an important complication that is assessed separately from the stages of retinopathy, as it can be associated with any of the DR stages and can run an independent course.

Table 1: International Classification of Diabetic Retinopathy and Diabetic Macular Edema

Diabetic Retinopathy	Findings Observable on Dilated Ophthalmoscopy
No apparent retinopathy	No abnormalities
Mild nonproliferative diabetic retinopathy	Microaneurysms only
Moderate nonproliferative diabetic retinopathy	More than: just microaneurysms, but Less than: severe nonproliferative DR
Severe nonproliferative diabetic Retinopathy	Any of the following: Intraretinal hemorrhages (20 or more in each of 1 quadrants); Definite venous beading (in 2 quadrants); Intraretinal microvascular abnormalities (in 1 quadrant); And no signs of proliferative retinopathy
Proliferative diabetic retinopathy	One or more of the following: Neovascularization, vitreous/preretinal hemorrhage

Diabetic Macular Edema	Findings Observable on Dilated Ophthalmoscopy [#]
Diabetic macular edema absent	No apparent retinal thickening or hard exudates in posterior pole
Diabetic macular edema present	Some retinal thickening or hard exudates in posterior pole
Mild diabetic macular edema:	Some retinal thickening or hard exudates in posterior pole but outside the central subfield of the macula (diameter 1000 microns)
Moderate diabetic macular edema:	Retinal thickening or hard exudates within the central subfield of the macula but not involving the center point
Severe diabetic macular edema:	Retinal thickening or hard exudates involving the center of the macula

[#] Hard exudates are a sign of current or previous macular edema. DME is defined as retinal thickening, and this requires a three-dimensional assessment that is best performed by a dilated examination using slit-lamp biomicroscopy and/or stereo fundus photography.

A simplified grading based on the referral decision can be used in low-resource areas (**Table 2**). It is important to remember that early macular edema may be first detected by a reduction in visual acuity.

An online self-directed course on the grading of diabetic retinopathy is available at: drgrading.iehu.unimelb.edu.au

Table 2: Referral Recommendations Based on Simplified Classification of Diabetic Retinopathy and Diabetic Macular Edema

Classification	Retinal Findings	Referral
No apparent retinopathy or mild nonproliferative DR (microaneurysms only)	No abnormalities or just microaneurysms	Review in one year for repeat screening (ophthalmologist not required)
Nonproliferative DR	Intraretinal hemorrhages, exudates but less than severe nonproliferative diabetic retinopathy	Routine referral within six months if possible (ophthalmologist not required)
Severe nonproliferative DR	1 Quadrant intraretinal microvascular abnormalities 2 Quadrants definite venous beading or 4 Quadrants intraretinal hemorrhages or And no signs of proliferative retinopathy	Semi-urgent referral within a few months if possible (ideally to an ophthalmologist)
PDR	Neovascularization or vitreous/preretinal hemorrhage	Urgent referral as soon as possible (ophthalmologist required)
DME without center involvement	Retinal thickening or hard exudates [#] in the macula but not involving the center of the macula	Semi-urgent referral within a few months if possible (ideally to an ophthalmologist)
Severe DME with center involvement	Retinal thickening or hard exudates [#] involving the center of the macula	Urgent referral as soon as possible (ophthalmologist required)

[#]Hard exudates are a sign of current or previous macular edema. DME is defined as retinal thickening, and this requires a three-dimensional assessment that is best performed by a dilated examination using slit-lamp biomicroscopy and/or stereo fundus photography. Reduced visual acuity can indicate early macular edema before hard exudates are noted.

II. Screening for Diabetic Retinopathy and Referral Guidelines

Screening for DR is an important aspect of DM management worldwide. Even if an adequate number of ophthalmologists are available, using ophthalmologists or retinal specialists to screen every person with DM is an inefficient use of resources.

A screening exam could include a complete ophthalmic examination with refracted visual acuity and state-of-the-art imaging. However, the minimum examination components to assure appropriate triage should include a screening visual acuity exam and retinal examination adequate for DR classification. Vision should be tested prior to pupil dilation.

Annex Figure 1 shows an example of the screening process for DR.

The screening vision exam should be completed by trained personnel in any of the following ways, depending on resources:

- Refracted visual acuity examination using a 3- or 4-meter visual acuity lane and a high contrast visual acuity chart.
- Presenting visual acuity examination using a near or distance eye chart and a pin-hole option if visual acuity is reduced.
- Presenting visual acuity examination using a 6/12 (20/40) equivalent handheld chart consisting of at least 5 standard letters or symbols and a pin-hole option if visual acuity is reduced.

A retinal examination may be accomplished in the following ways:

- Direct or indirect ophthalmoscopy or slit-lamp examination of the retina.
- Retinal (fundus) photography (including any of the following: widefield to 30o; mono or stereo; dilated or undilated). This could be done with or without accompanying optical coherence tomography (OCT) scanning. This could include telemedicine approaches. (**Annex Table 3**)
- For the retinal examination, a medical degree may not be necessary, but the examiner must be well trained to perform ophthalmoscopy and to assess the severity of retinopathy or perform retinal photography. Those assessing the photography must be proficient in assessing retinopathy severity.

Using adequate information from the visual acuity and retinal examinations, one can decide on an appropriate management plan, as outlined in **Table 2**. The plan may be modified based on individual patient requirements.

Patients with less than adequate retinal assessment should be referred to an ophthalmologist unless it is obvious that there is no retinopathy, or at most, only microaneurysms. In addition, persons with unexplained visual-acuity loss should be referred.

As part of a screening exam, persons with diabetes should be asked about their diabetes control, including blood glucose testing, blood pressure, and serum lipids. In addition, women should be asked if they could be pregnant. Problems in any of these areas require appropriate medical intervention.

At a minimum, in a low-resource setting, a screening exam must include a test of presenting visual acuity and a retinal exam that is either dilated ophthalmoscopy or retinal photography.

Referral Guidelines

Minimum referral guidelines are as follows:

- Visual acuity decrease below 6/12 (20/40) or symptomatic vision complaints
- DR can be classified according to the ICO Guidelines or International Classification (see below):
 - » No retinopathy or mild DR: return for screening exam in 1–2 years
 - » Moderate DR: return for screening exam in 6 months to 1 year; or refer to ophthalmologist
 - » Severe nonproliferative DR or PDR: refer to ophthalmologist
 - » DME: refer to ophthalmologist
- If retinal exam or retinal imaging is available but only a less detailed classification is possible:
 - » No retinopathy or only a few small red spots: return for screening exam in 1–2 years
 - » Dot or blot hemorrhages or possible neovascularization: refer to ophthalmologist
 - » White spots in the retina: refer to ophthalmologist
- If visual acuity or retinal examination cannot be obtained at the screening examination: refer to ophthalmologist.
- Patients who have had laser treatment should be referred for ophthalmic review.

III. Detailed Ophthalmic Assessment of Diabetic Retinopathy

1. Initial Patient Assessment

Detailed patient assessment should include a complete ophthalmic examination, including visual acuity and the identification and grading of DR severity and presence of DME for each eye. The patient assessment should also include the taking of a patient history focused on diabetes and its modifiers.

a. Patient History (Key Elements)

- Duration of diabetes
- Past glycemic control (hemoglobin A1c)
- Medications (especially insulin oral hypoglycemics, antihypertensives, and lipid-lowering drugs)
- Systemic history (e.g., renal disease, systemic hypertension, serum lipid levels, pregnancy)
- Ocular history

b. Initial Physical Exam (Key Elements)

- Visual acuity
- Measurement of intraocular pressure (IOP)
- Gonioscopy when indicated (e.g., when neovascularization of the iris is seen or in eyes with increased IOP)
- Slit-lamp biomicroscopy
- Fundus examination

c. Fundus Examination Assessment Methods

Currently, the two most sensitive methods for detecting DR are retinal photography and slit-lamp biomicroscopy through dilated pupils. Both depend on interpretation by trained eye health professionals. Other methods are listed in **Annex Table 2**.

Fundus photography has the advantage of creating a permanent record, and for that reason, it is the preferred method for retinopathy assessment. However, well-trained observers can differentiate diabetic retinopathy without photography and there are many situations in which that would be the examination of choice.

The availability of human and equipment resources is highly variable. However even in the most resource-poor countries, there are often centers that have more sophisticated methods available.

The use of all instruments requires training and competence but more skill is needed for indirect ophthalmoscopy and slit-lamp biomicroscopy than for fundus photography. Newer, semiautomatic nonmydriatic cameras can be very easy to use. Media opacities will lead to image/view degradation and all photographs/images must be reviewed by trained personnel.

2. Follow-up Examination of Patients with Diabetic Retinopathy

In general, the follow-up history and examination should be similar to the initial examination. The assessment of visual symptoms, visual acuity, measurement of IOP, and fundus examination are essential.

a. Follow-up History

- Visual symptoms
- Glycemic status (hemoglobin A1c)
- Systemic status (e.g., pregnancy, blood pressure, serum cholesterol, renal status)

b. Follow-up Physical Exam

- Visual acuity
- Measurement of IOP
- Fundus examination
- Slit-lamp biomicroscopy with iris examination
- Gonioscopy when indicated (e.g., when neovascularization of the iris is suspected, or in eyes with increased IOP)

c. Ancillary Tests

- Fluorescein angiography is not needed to diagnose DME or PDR, both of which are diagnosed by means of the clinical exam.
- Fluorescein angiography can be used as a guide for treating DME and as a means of evaluating the cause(s) of unexplained decreased visual acuity. Angiography can identify macular capillary nonperfusion or sources of capillary leakage resulting in macular edema as possible explanations for visual loss.
- OCT is the most sensitive method to identify sites and severity of retinal edema.

d. Patient Education

- Discuss results of exam and implications.
- Encourage patients with DM but without DR to have annual dilated eye exams.
- Inform patients that effective treatment for DR depends on timely intervention, despite good vision and no ocular symptoms.
- Educate patients about the importance of lowering serum lipid levels and maintaining near-normal glucose levels and near-normal blood pressure.
- Communicate with the attending physician (e.g., family physician, internist, or endocrinologist) regarding eye findings.
- Provide patients whose conditions fail to respond to surgery and for whom treatment is unavailable with proper professional support (i.e., offer referrals for counseling, rehabilitative, or social services as appropriate).
- Refer patients with reduced visual function for vision rehabilitation and social services.

Table 3. Follow-up Schedule for Diabetic Retinopathy Severity According to Resources Available

For all patients regardless of retinopathy severity optimize medical treatment for glycemic control, hypertension, and elevated serum lipids.

Follow up Schedule	Low-Resource Settings	Intermediate Resource Settings	Resource-Rich Settings
No apparent DR	Repeat examination biannually	Repeat examination biannually	Repeat examination annually
Mild nonproliferative DR	Repeat examination biannually	Repeat examination biannually unless annually if poor glycemic control	Repeat examination annually
Moderate nonproliferative DR without DME	Repeat examination annually	Repeat examination annually	Repeat examination within 6-12 months
Severe NPDR without DME	Panretinal photocoagulation	Panretinal photocoagulation	Panretinal photocoagulation
DME	Focal/Grid laser photocoagulation	Focal/Grid laser photocoagulation	Focal/Grid laser photocoagulation

IV. Treatment of Diabetic Retinopathy

Panretinal photocoagulation surgery may be considered as patients approach PDR. There are benefits of early panretinal photocoagulation at the severe nonproliferative DR stage for patients with type 2 diabetes. Other factors, such as poor compliance with follow up, impending cataract extraction or pregnancy, and status of fellow eye will help in determining the timing of the panretinal photocoagulation.

1. Panretinal Photocoagulation (PRP)

a. Pretreatment discussion with patients

- Patients usually need numerous follow-up visits and may require supplementary laser treatment.
- PRP reduces the risk of visual loss and blindness. This has been demonstrated scientifically in a study involving more than 1,700 patients.
- Although laser treatment is effective, some patients may still develop vitreous hemorrhage. The hemorrhage is caused by the diabetes and not by the laser; it may mean the patient needs more laser treatment.
- Laser treatment often reduces peripheral and night vision; treatment may moderately reduce central vision. This short-term side effect is compensated by the significant long-term reduction in severe vision loss and blindness in laser-treated patients.

b. Lenses for PRP

- The three-mirror Goldmann contact lens has a central opening for treating the posterior pole, and side mirrors for treating the mid peripheral and peripheral retina. Disadvantages: small field of view, which requires continual manipulation of the lens to complete treatment. Spot size is set at 500μ.
- Newer wide-angle contact lenses are often used. Although the image is inverted, there is a large field of view allowing for many burns with the field while easily maintaining orientation to the disc and macula. The optics of these wide-angle lenses will affect the laser spot size on the retina (**Table 4**). Wide-angle indirect ophthalmoscopy lenses provide an inverted image, but show a large field of view and a magnification of the spot in the retina (**Table 4**). Scatter treatment can be applied to a large area of retina in a single image, and it is easy to visualize the disk and the macula.

Table 4: Laser Spot Size Adjustment Required for Different Lenses Contact

Lens	Field of Vision	Axial magnification	Spot magnification	Spot Size Setting for ~500 micron burn
Mainster Wide-Field	125°	0.46	1.50x	300μ
Volk TransEquator	120-125°	0.49	1.43x	300μ
Volk Quad/Aspheric	130-135°	0.27	1.92x	200 to 300μ
Mainster PRP 165	160°	0.27	1.96x	200 to 300μ

c. Technique for PRP

- i. The pupil should be fully dilated and topical anesthesia is used. Retrobulbar or subtenons anesthesia to reduce pain and decrease eye motion can be employed as necessary.
- ii. The most common wavelengths used are Argon green, blue green (generally avoided currently), and 532 green laser, using the slit-lamp delivery system. In case of hazy media, Krypton red or diode red laser (814 nm) can be used. Slit-lamp treatment is most commonly done through a contact lens but can also be performed using indirect ophthalmoscopy. For example, when treatment is given under general anaesthetic.
- iii. Typical initial settings on the Argon laser would be 500 μm spot size, a 0.1 second exposure and 250-270 mw power. The power is gradually increased until a whitish reaction is obtained on the retina. The lesions are placed 1 burn width apart. **(Table 5)**
- iv. A total of 1600-3000 burns are placed in 1 or more sittings, carefully avoiding the macular area and any areas of tractional elevation of the retina. The burns are placed 2 to 3 disc diameters away from the center of the macula and 1 disc diameter away from the disc, usually outside the arcades and extended peripherally up to the equator and beyond.
- v. Laser treatment should not be applied over major retinal veins, preretinal hemorrhages, darkly pigmented chorioretinal scars, or within 1 DD (200-300 μm) of center of macula, so as to avoid risk of hemorrhage or large scotomas.
 - Additional photocoagulation is needed if there is evidence of worsening of proliferative retinopathy.
 - Add burns in between scars of initial treatment further peripherally and also at the posterior pole, sparing the area within 500-1500 μ from the center of the macula.
 - Favor quadrants with active new vessels or areas with intraretinal microvascular abnormalities where scars are more widely spaced and areas of severe ischemia not previously treated, such as the temporal part of the posterior pole.
 - Direct treatment of NVE in between scars
 - A subthreshold micropulse diode laser or multi-spot laser can be used.

d. Panretinal (Scatter Photocoagulation Technique) Diabetic Retinopathy Clinical Research Group Consensus

Panretinal (scatter) photocoagulation initially consists of 1200 to 1600 burns (or the equivalent area treated with a multi-spot laser), with a spot size on the retina of approximately 500 microns given over 1 to 3 sittings and completed within eight weeks (56) days of initiation. **(Table 5)**

Table 5. The burn characteristics for nonautomated photocoagulation:

Size (on retina):	500 microns [e.g. argon laser using 200 micron spot size with Rodenstock lens (or equivalent) or 500 micron spot size with 3 mirror contact lens]
Exposure:	0.1 seconds recommended, 0.05 to 0.2 allowed
Intensity:	mild white (i.e. 2+ to 3+ burns)
Distribution:	edges 1 burn width apart
Number of sessions/sittings:	1 to 3
Nasal proximity to disk:	No closer than 500 microns
Temperature proximity to center:	No closer than 3000 microns
Superior/inferior limit:	No further posterior than 1 burn within the temporal arcades
Extent:	Arcades (~3000 microns from the macular center) to at least the equator
Total number of burns:	1200 – 1600 There may be instances where 1200 burns are not possible such as the development of vitreous hemorrhage or inability to complete a sitting precluding completion of the PRP session. Similarly, there may be clinical situations in which more than 1600 burns are needed such as initial difficulty with laser uptake due to media opacity.
Wavelength:	Green or yellow (red can be used if vitreous hemorrhage is present)

2. Treatment For Diabetic Macular Edema

a. Resource-Rich Settings

- i. Optimize medical treatment: Improve glycemic control if HbA1c > 7.5% as well as any associated arterial hypertension or with high lipids.
- ii. DME without center involvement (e.g., circinate [lipid] ring threatening the center of the macula or when no vision loss has occurred in spite of center involvement): Consider focal laser to leaking microaneurysms. No treatment is applied to lesions closer than 300 µm from the center of the macula.
- iii. DME with center involvement and associated vision loss: intravitreal anti- VEGF treatment (e.g., with ranibizumab [Lucentis], bevacizumab [Avastin], or Aflibercept [Eylea]) therapy. Consideration should be given to monthly injections followed by treatment interruption and re-initiation based on visual stability and OCT. Patients should be monitored almost monthly with OCT to consider the need for treatment. Typically, the number of injections is 8 the first year, 2 or 3 during the second year, and 1 to 2 during the third year. Persistent retinal thickening and leaking points: consider laser treatment after 24 weeks. Treatment with intravitreal triamcinolone may be considered, especially in pseudophakic eyes. (**Annex Figures 3 and 4**). The usual dosage of bevacizumab is 0.3 mg. Injections are given 4 mm behind the limbus in the inferotemporal quadrant under topical anaesthesia using a sterile technique.
- iv. DME associated with high-risk proliferative DR: combined intravitreal anti-VEGF therapy and PRP should be considered. A clinical trial is underway to assess whether anti-VEGF alone might be sufficient treatment.
- v. Pars plana vitrectomy is indicated if the OCT demonstrates vitreomacular traction or an epiretinal membrane.

For eyes with good visual acuity (20/25 or better) and center-involved DME, 3 treatment options being evaluated in an ongoing clinical trial include: (1) careful follow-up with anti-VEGF treatment only for worsening DME; (2) anti-VEGF injections; or (3) laser photocoagulation with anti-VEGF, if necessary.

Table 6. Modified-ETDRS (mETDRS) and the Mild Macular Grid (MMG) Laser Photocoagulation Techniques

Burn Characteristic	Direct/Grid Photocoagulation (Modified-ETDRS technique)	Mild Macular Grid Photocoagulation Technique
Direct treatment	Directly treat all leaking microaneurysms in areas of retinal thickening between 500 and 3000 microns from the center of the macula (but not within 500 microns of disc)	Not applicable
Change in MA color with direct treatment	Not required, but at least a mild gray-white burn should be evident beneath all microaneurysms	Not applicable
Burn size for direct treatment	50 microns	Not applicable
Burn duration for direct treatment	0.05 to 0.1 sec	Not applicable
Grid treatment	Applied to all areas with diffuse leakage or nonperfusion within area described below for treatment	Applied to entire area described below for treatment (including unthickened retina)
Area considered for grid treatment	500 to 3000 microns superiorly, nasally and inferiorly from center of macula 500 to 3500 microns temporally from macular center No burns are placed within 500 microns of disc	500 to 3000 microns superiorly, nasally and inferiorly from center of macula 500 to 3500 microns temporally from macular center No burns are placed within 500 microns of the disc
Burn size for grid treatment	50 microns	50 microns
Burn duration for grid treatment	0.05 to 0.1 sec	0.05 to 0.1 sec
Burn intensity for grid treatment	Barely visible (light gray)	Barely visible (light gray)
Burn Separation for Grid Treatment	Two visible burn widths apart	200 to 300 total burns evenly distributed over the treatment area outlined above (approx. two to three burn widths apart)
Wavelength (grid and focal Treatment)	Green to yellow wavelengths	Green

b. Intermediate or Low-Resource Settings

- Generally similar to above. Focal laser is preferred if intraocular injection of anti-VEGF agents are not available. Bevacizumab (Avastin) is an appropriate alternative to raniziumab (Lucentis) or aflicercept (Eyelea). Laser can be applied earlier to areas of persistent retinal thickening in eyes unresponsive to anti-VEGF treatment.

c. Laser Technique for Macular Edema

- Focal macular treatment includes focal laser treatment of microaneurysms and grid treatment of areas of diffuse leakage and focal nonperfusion within 2DD of center of the macula. **(Table 6)**
- Laser parameters used are a 200 or 100 µm spot size, 120 to 150 mW energy and very light gray intensity of the burn. Care is taken to demarcate and avoid the foveal avascular zone.
- If DME is associated with large areas of macular ischemia, only the areas of retinal thickening are treated.

3. Indications for Vitrectomy

- Severe vitreous hemorrhage of 1–3 months duration and that does not clear spontaneously.
- Advanced active PDR that persists despite extensive panretinal photocoagulation.
- Traction macular detachment of recent onset.
- Combined traction-rhegmatogenous retinal detachment.
- Tractional macular edema or epiretinal membrane involving the macula.

V. Suggested Indicators for Evaluation of DR Programs

- a. Prevalence of diabetic retinopathy related blindness and visual impairment*
- b. Proportion of blindness and visual impairment due to DR*
- c. Last eye examination for DR among known diabetics (males/females)*
 - Never had eye examination for DR
 - 0–12 months ago
 - 13–24 months ago
 - >24 months ago
 - Could be simplified as: never/0-12 months ago/>12 months ago
- d. Number of patients who were examined for DR during last year
- e. Number of patients who received diabetic retinopathy laser and/or anti-VEGF treatment during last year

This absolute number could be used to define ratios such as:

- f. Number of patients who received laser and/or anti-VEGF treatments per million population per year [equivalent to Cataract Surgical Rate (CSR)]
- g. Number of patients who received laser and/or anti-VEGF treatments per number of diabetic patients in a given area (hospital catchment area, health district, region, country)
 - Numerator: number of laser treatments during the last year
 - Denominator: number of diabetic patients (population x prevalence of DM; source: IDF Atlas)
- h. Number of patients who received laser and/or anti-VEGF treatments per number of diabetic retinopathy patients in a given area (hospital catchment area, health district, region, country)
 - Numerator: number of laser treatments during the last year
 - Denominator: number of DR patients (population x prevalence of DM x 0.117; source: IDF Atlas)

* Data available from RAAB surveys

0.117: Estimated average prevalence of vision-threatening DR.

Yau JW, Rogers SL, Kawasaki R, et al. Global Prevalence and Major Risk Factors of Diabetic Retinopathy. *Diabetes Care*. Mar 2012;35(3):556-564.

VI. Guidelines for Screening, Assessing, and Treating Diabetic Eye Disease

To create the *ICO Guidelines for Diabetic Eye Care*, the ICO collected guidelines from around the world for screening, assessing, and treating diabetic eye disease. This is part of a new initiative to reduce worldwide vision loss related to diabetes.

View the collected guidelines at: www.icoph.org/taskforce-documents/diabetic-retinopathy-guidelines.html

In addition to creating a consensus on technical guidelines, as encompassed in the *ICO Guidelines for Diabetic Eye Care*, these resources will also be used to focus on:

- Incorporating the critical competencies into ICO curricula and stimulating improved training and continuing professional development to meet public needs.
- Developing a framework for evaluation of public health approaches and stimulating development, strengthening, and monitoring of relevant health systems.

Please email info@icoph.org if you have any questions.

ICO GUIDELINES FOR DIABETIC RETINOPATHY ANNEXES

Annex Table 1: Features of Diabetic Retinopathy (also see the photographs continued in the annex)

Feature	Description	Assessment Considerations
Microaneurysms	Isolated, spherical, red dots of varying size. They may reflect an abortive attempt to form a new vessel or may simply be a weakness of capillary vessel wall through loss of normal structural integrity.	They are easiest seen on fluorescein angiography
Dot hemorrhages	Dot haemorrhages cannot always be differentiated from microaneurysms as they are similar in appearance but with varying size.	The term dot hemorrhage/ microaneurysm (H/Ma) is often used.
Blot hemorrhages	Formed where clusters of capillaries occlude leading to formation of intraretinal blot haemorrhages.	The lesion can be seen to be in the outer plexiform layer on fluorescein angiography where it does not mask the overlying capillary bed unlike dot and flame hemorrhages, which lie more superficially in the retina.
Cotton wool spots	These represent the swollen ends of interrupted axons where build-up of axoplasmic flow occurs at the edge of the infarct.	These features are not exclusive to DR and do not in themselves appear to increase the risk of new vessel formation. For example, they may occur in hypertension HIV/AIDS.
Intraretinal microvascular anomalies	These are dilated capillary remnants following extensive closure of capillary network between arteriole and venule. Associated features include: <ul style="list-style-type: none"> • venous beading (foci of venous endothelial cell proliferation that have failed to develop into new vessels), • Venous reduplication (rare), • Venous loops (thought to develop due to small vessel occlusion and opening of alternative circulation) and • Retinal pallor and white vessels 	They are easiest seen on fluorescein angiography.
Macular changes In nonproliferative retinopathy – Macular edema – Macrovascular disease	Thickening of retina takes place due to accumulation of exudative fluid from damaged outer blood-retina barrier (extracellular edema) or as a result of hypoxia, leading to fluid accumulating within individual retinal cells (intracellular edema). It may be focal or diffuse. Flame hemorrhage and cotton wool spot formation. May occur due to arteriolar occlusion, without capillary occlusion, which frequently affects the horizontal nerve fiber layer of the retina.	The appearance of macular edema can be appreciated on stereoscopic examination or inferred by the presence of intraretinal exudate.
Optic disc changes	Occasionally swollen optic discs may be seen (diabetic papillopathy) in diabetic patients.	In diabetic papillopathy, vision is usually not significantly impaired.

Annex Table 2: Features of Proliferative Diabetic Retinopathy

Feature	Description	Assessment Considerations
New vessels at the disc (NVD)	New vessels at the discs usually arise from the venous circulation on the disc or within 1 disc diameter of the disc NVD.	In order to differentiate NVD from fine normal small blood vessels note that the latter always taper to an end and do not loop back to the disc, while NVD always loop back, may form a chaotic net within the loop, and have the top of the loop of wider diameter than the base.
New vessels elsewhere (NVE)	New vessels, which usually occur along the border between healthy retina and areas of capillary occlusion.	Not to be confused with intraretinal microvascular abnormalities, which occur within areas of capillary occlusion.
Other sites of new vessels	New vessel formation on the iris - NVI (proliferative iridopathy) is uncommon but represents potentially more advanced ischemic changes. New vessel formation on the anterior hyaloid surface occurs rarely postvitrectomy if insufficient laser has been applied to the peripheral retina.	It is useful to perform gonioscopy in such cases to exclude new vessels in the anterior chamber angle (NVA), which can lead to neovascular glaucoma.
Fibrous proliferation	In proliferative retinopathy, new vessels grow on a platform of glial cells	

Adapted from British The Royal College of Ophthalmologists Diabetic Retinopathy Guidelines December 2012.

Annex Table 3: Available Assessment Instruments and Their Advantages and Disadvantages

Technique	Advantages	Disadvantages	Recommendation
Direct ophthalmoscopy [#]	<ul style="list-style-type: none"> • Mobile • Inexpensive 	<ul style="list-style-type: none"> • Requires pupil dilation • Small field • Low sensitivity: even with a trained practitioner and red free illumination, small microvascular abnormalities may be difficult to detect • Less effective than slit-lamp biomicroscopy through dilated pupils • No ability to retrospectively audit 	<ul style="list-style-type: none"> • Optional for screening • Pupils must be dilated
Indirect ophthalmoscopy [#]	<ul style="list-style-type: none"> • Mobile • Large field • Relatively inexpensive 	<ul style="list-style-type: none"> • Requires pupil dilation • Even with a trained practitioner and red free illumination, small microvascular abnormalities may be difficult to detect • Less effective than slit-lamp biomicroscopy through dilated pupils • No ability to retrospectively audit 	<ul style="list-style-type: none"> • Optional for screening • Pupils must be dilated
Slit-lamp biomicroscopy	<ul style="list-style-type: none"> • Large field 	<ul style="list-style-type: none"> • Requires pupil dilation • Immobile • Requires special lenses • No ability to retrospectively audit 	<ul style="list-style-type: none"> • Required for ophthalmic examination
Nonmydriatic retinal photography	<ul style="list-style-type: none"> • Large field • Can be used by non-medically trained staff • No dilation required in 80-90% of cases • Some are portable - can be transported to the community in mobile units • Can be linked to computers and images can be stored for the long term • Allows objective comparison of the same person, or between different groups of people, examined at different times or by different professionals • Can be used as a patient education tool, giving immediacy and personal relevance • Readily recalled for evaluation of screener performance and audit of grading 	<ul style="list-style-type: none"> • Relatively expensive • A dark space is required for maximum pupil dilation • Auditable 	<ul style="list-style-type: none"> • Recommended for screening

(Continued) Annex Table 3: Available Assessment Instruments and Their Advantages and Disadvantages

Technique	Advantages	Disadvantages	Recommendation
Nonmydriatic retinal photography used with mydriasis	<ul style="list-style-type: none">As above except pupils are dilated for better quality photos	<ul style="list-style-type: none">As aboveRequires pupil dilation	<ul style="list-style-type: none">Optional
Mydriatic retinal photography (conventional fundus camera)	<ul style="list-style-type: none">Large field	<ul style="list-style-type: none">Requires pupil dilationExpensiveBright flash constricts the pupil for a long time	<ul style="list-style-type: none">Desirable in ophthalmic center
Fluorescein angiography	<ul style="list-style-type: none">Only method of assessing capillary circulation	<ul style="list-style-type: none">Invasive and needs general health status assessmentExpensiveDilatation neededCannot be used by non-medically trained staff	<ul style="list-style-type: none">Desirable in ophthalmic center
OCT	<ul style="list-style-type: none">One of the best ways to assess macular edema (retinal thickening and intraretinal edema)	<ul style="list-style-type: none">ExpensiveDilatation neededCannot be used by non-medically trained staff	<ul style="list-style-type: none">Desirable in ophthalmic center
Fundus autofluorescence	<ul style="list-style-type: none">A form of functional imaging, giving insights into the metabolic activity of the retinal pigment epithelium.	<ul style="list-style-type: none">Role not clearly understood	<ul style="list-style-type: none">Optional high-resource settings

Equipment

Core/essential: for screening, initial assessment, and follow up:

- Nonmydriatic retinal photography (recommended for screening).
- Indirect ophthalmoscopy (optional for screening, panoramic view, low magnification). Pupils must be dilated.
- Noncontact biconvex indirect lenses used with the slit lamp (90 D for screening, 78 D for more magnification).
- Direct ophthalmoscopy (optional for screening). Pupils must be dilated.
- Three-mirror contact lens used with slit lamp for stereoscopic and high-resolution images of the macula (evaluation of macular edema). Pupils must be dilated.
- Slit-lamp biomicroscope.
- Laser equipment: Currently, the most used lasers are (1) The green laser: a.- 532 nm, frequency-doubled Nd:YAG. b.- 514 nm argon laser. (2) The 810 nm infrared laser, or diode laser; cause deeper burns with a higher rate of patient discomfort, but tend to be cheaper, is effective, and requires less maintenance.

Desirable in reference centers:

- OCT
- Fluorescein angiography
- Mydriatic retinal photography (large field conventional fundus camera)
- Green lasers are the most used, but the pattern-laser method, with a predetermined multispot treatment cascade and the 577 nm yellow laser can be used in selected cases

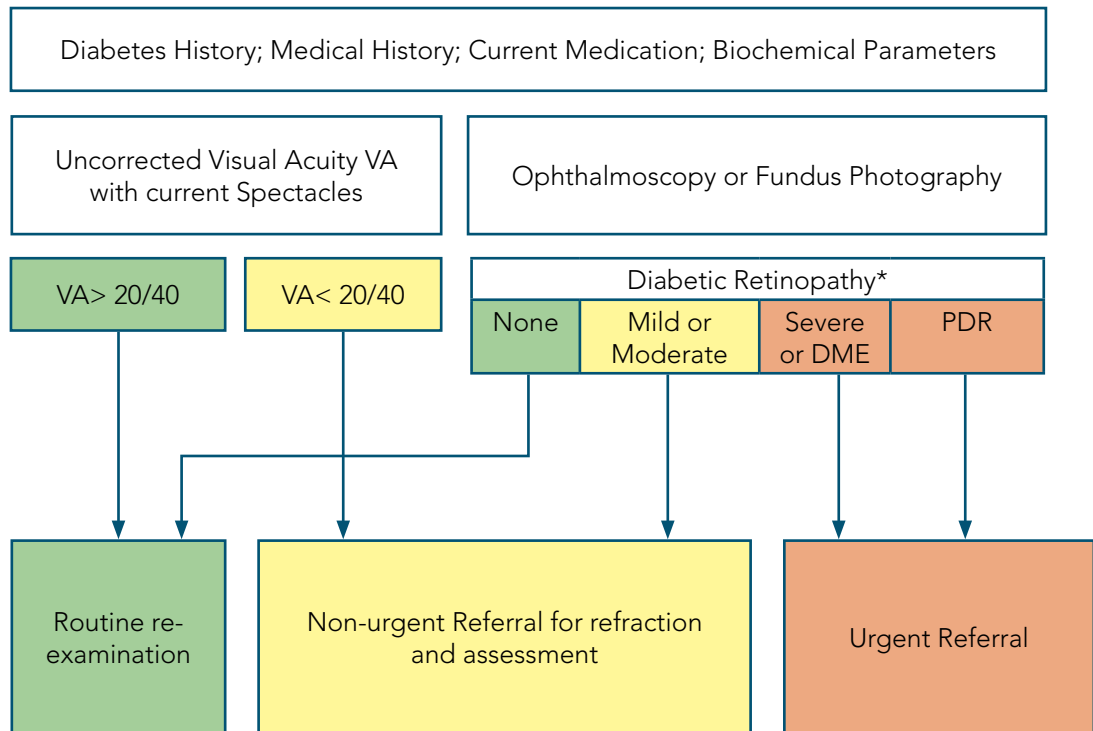
IAPB Standard List of Equipment

The online version of the International Agency for the Prevention of Blindness (IAPB) Standard List provides information for eye health providers on a carefully evaluated range of eye care technologies, supplies, and training resources suitable for use in settings with limited resources.

For more information and to get access, please register and log on at [IAPB.standardlist.org](https://iapb.org/standardlist).

Only registered users have access to the IAPB Standard List catalogue. Please be aware the registration process may take a few days for approvals to be granted.

Figure 1: Screening for Diabetic Retinopathy



*Need to optimize medical treatment; glycemic control, hypertension and lipids.

Figure 2: Treatment decision tree of DME based on Center-Involvement and Vision

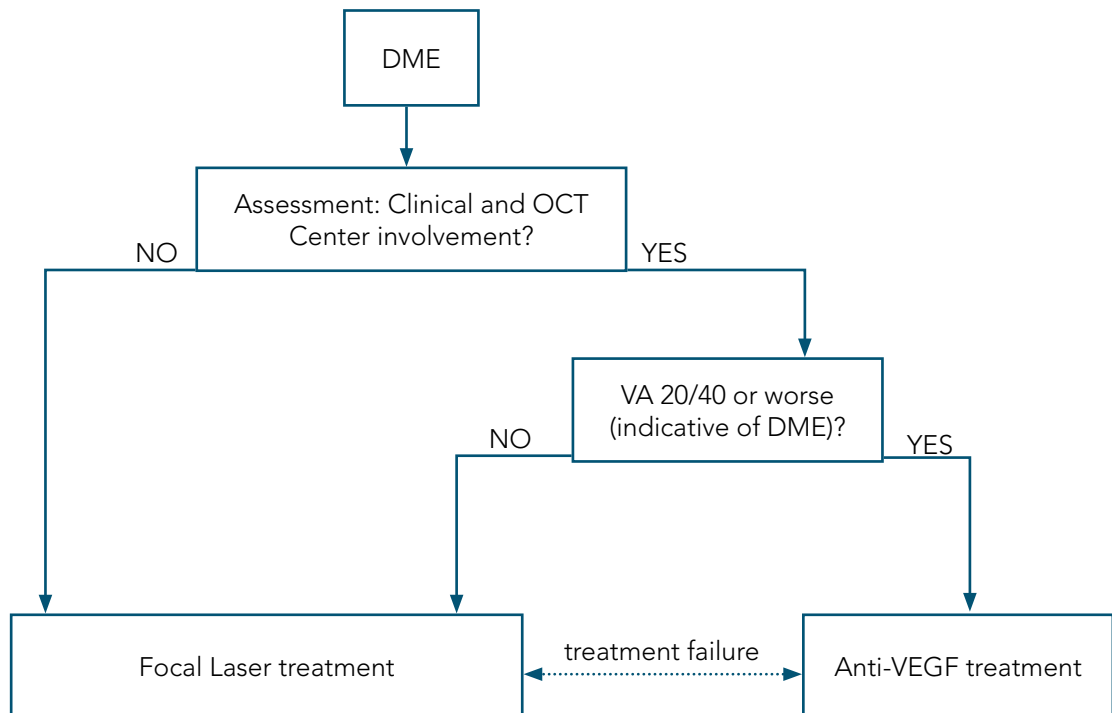


Figure 3: anti-VEGF treatment decision tree based on the RESTORE study treatment and re-treatment schedule

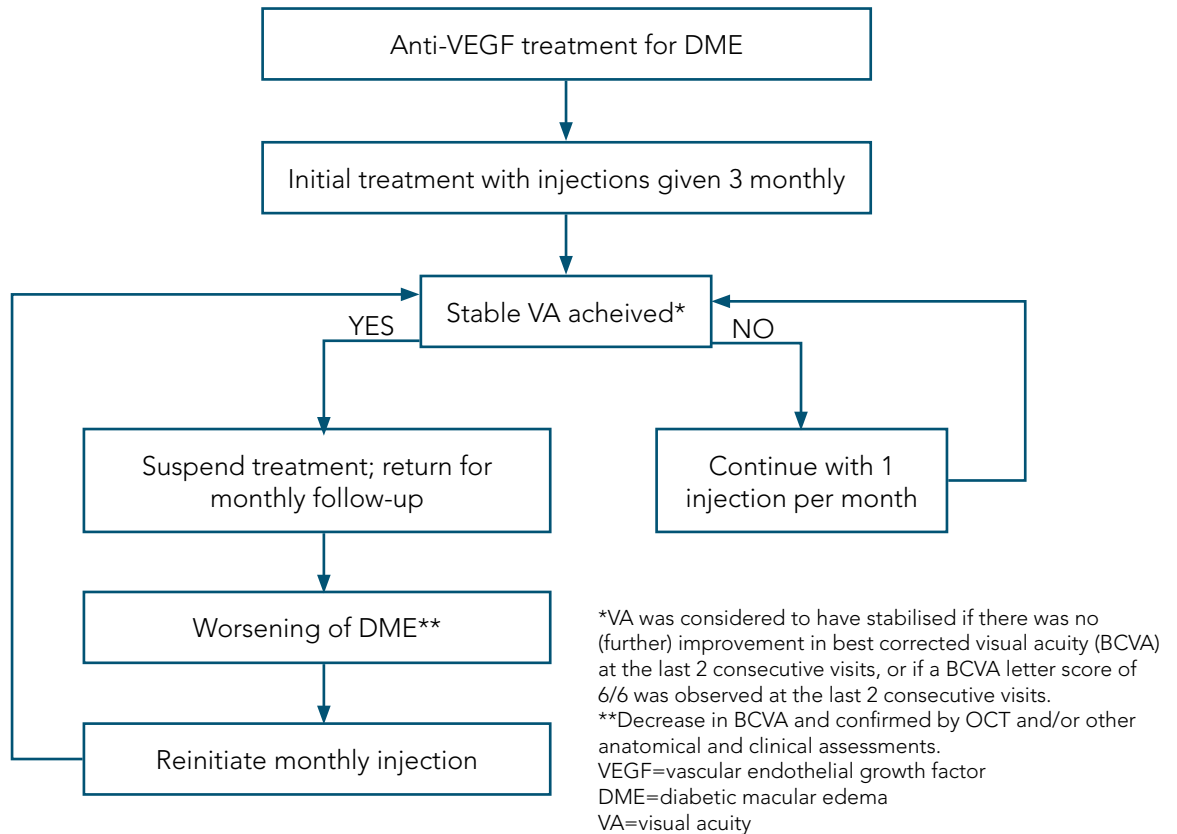
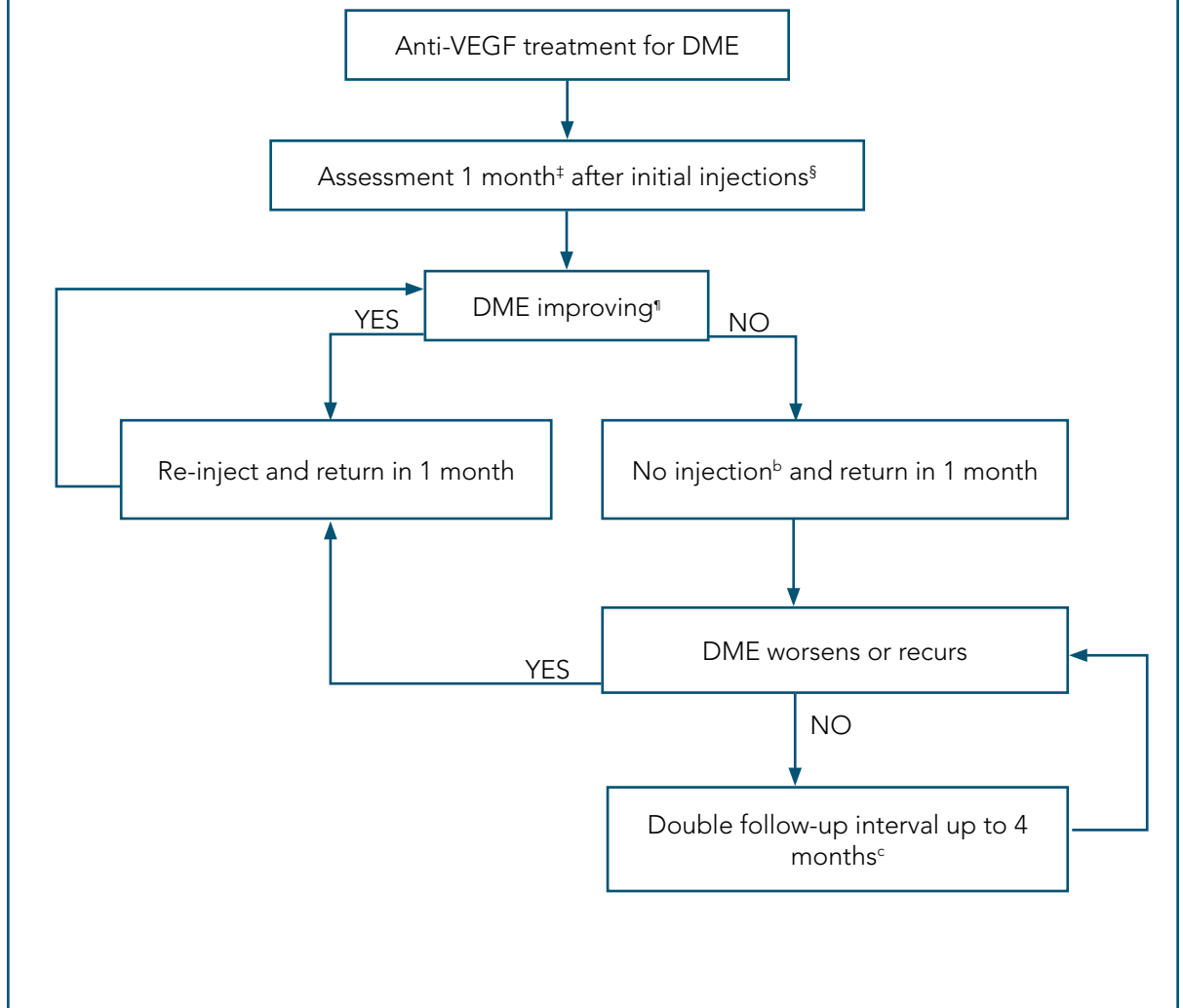
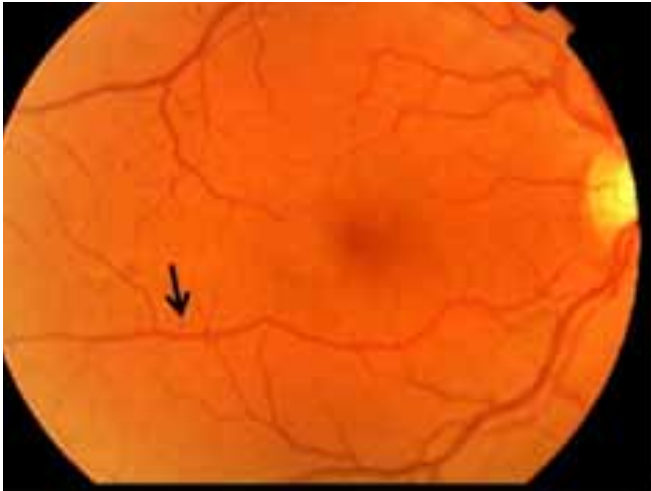


Figure 4: Anti-VEGF treatment decision tree based on the DRCR.net re-treatment and follow-up schedule

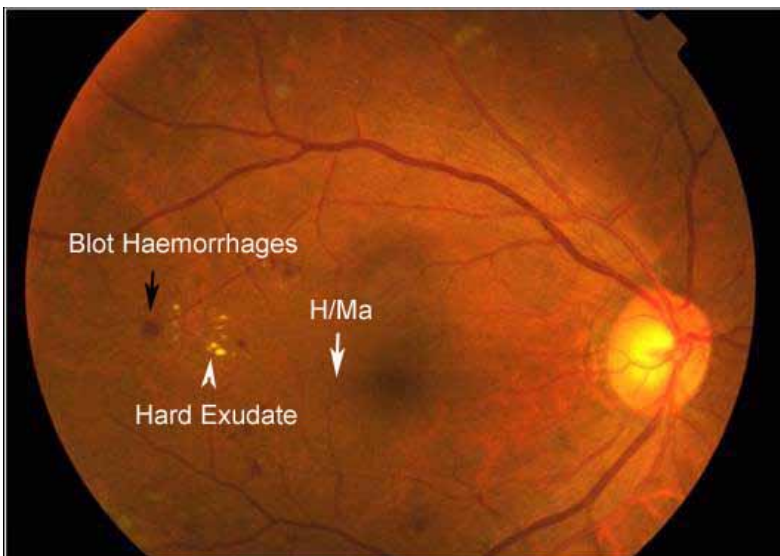


†In the DRCR.net study, 4-week, not 1-month, intervals were used. §The DRCR.net study required 4 injections of intravitreal ranibizumab every 4 weeks initially; it is not known whether a different number of injections initially would have worked as well. DRCR.net also required 2 additional injections at months 5 and 6 if edema persisted and success had not been met, even in the absence of improvement. ¶Relevant details from the DRCR.net study: 1) DRCR.net “improvement” on Zeiss Stratus OCT >10% decrease in central subfield thickness; 2) Even if no longer improving on OCT, injections continued if VA “improvement” (unless 6/6 or better); 3) VA improvement defined as 5 or more letter increase on Electronic Early Treatment Diabetic Retinopathy Study Visual Acuity Test. aIn the DRCR.net study, if focal/grid laser was deferred at baseline, it was added at or after 24 weeks if edema still present and OCT central subfield and vision no longer improving. bIn the DRCR.net study, all patients received at least 4 injections 4 weeks apart. The decision to re-inject was at investigator discretion, starting at 16 weeks for “success”, defined as VA better than 6/6 or OCT central subfield <250 µm. Starting at 24 weeks, re-injection was also at investigator discretion if no improvement in OCT central subfield or vision. cThe DRCR.net study continued follow-up every 4 weeks through the 52-week visit and did not permit extension of follow-up until after the 52-week visit. If injection was withheld due to no improvement or success at 3 consecutive visits following the week 52 visit, follow-up interval was doubled to 8 weeks and then again to 16 weeks if still no change. VEGF= vascular endothelium growth factor.

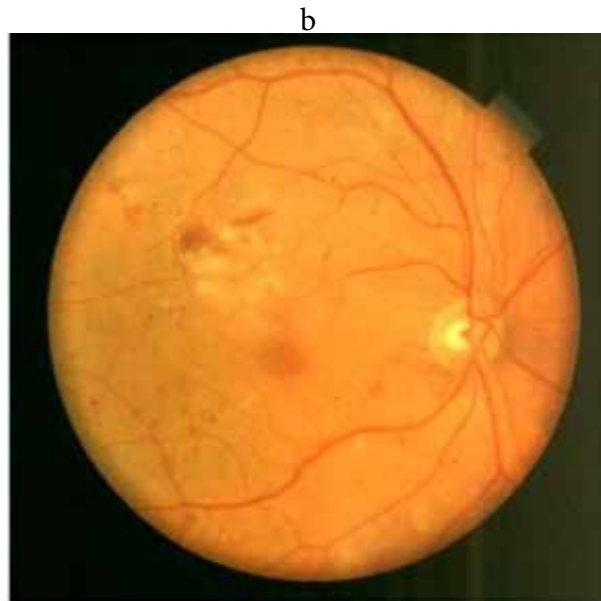
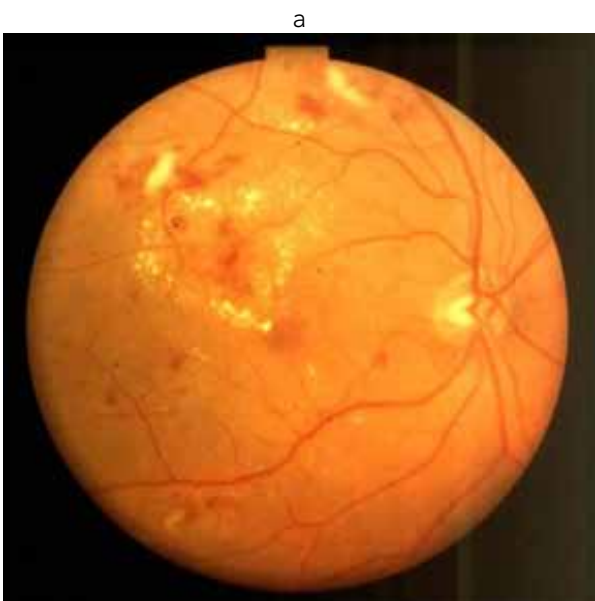
Photographs



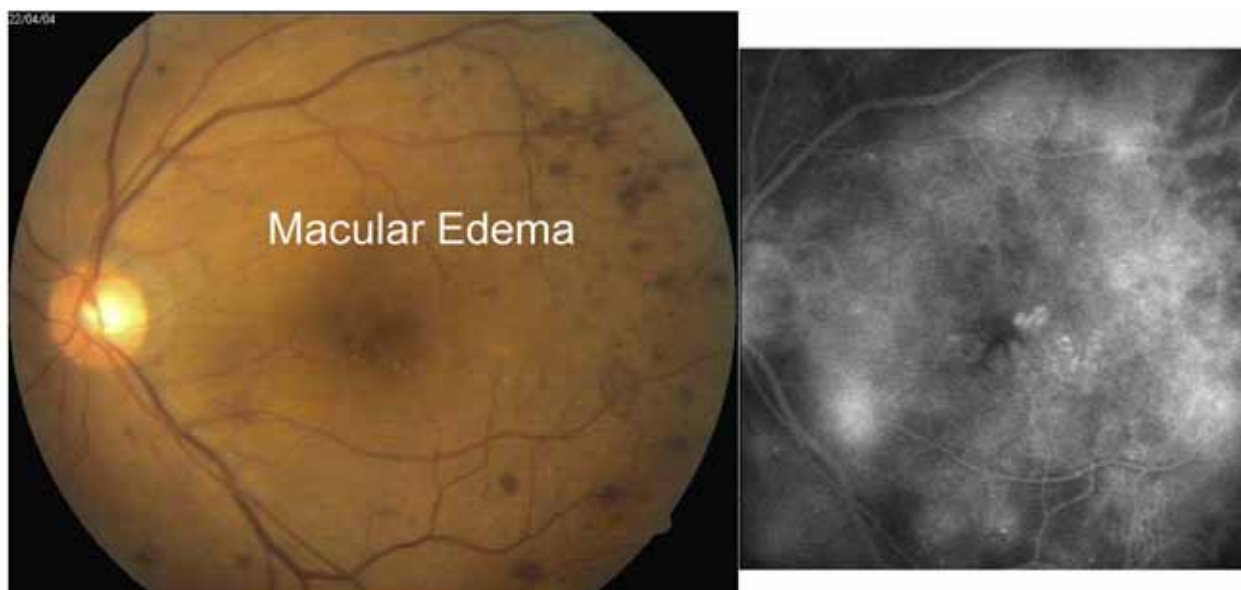
Mild non proliferative diabetic retinopathy: microaneurysms



Mild non proliferative diabetic retinopathy with hemorrhages, hard exudates and micro aneurysms, with no macular edema.



Mild (moderate) non proliferative diabetic retinopathy. Moderate macular edema, hard exudates approaching the center of the macula. Before (a) and after (b) focal laser therapy.



Moderate non proliferative diabetic retinopathy with moderate diabetic macular edema (Fluorescein angiography shows leakage)



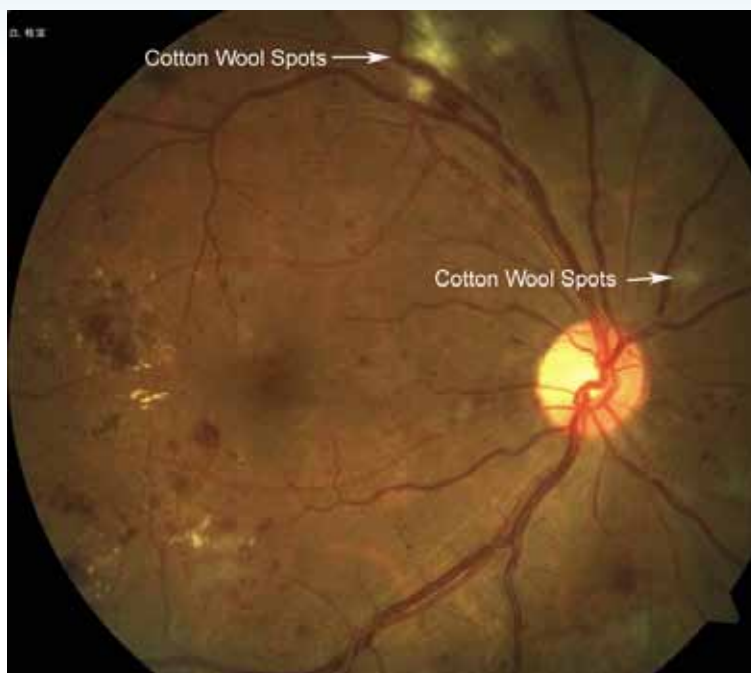
Severe non proliferative diabetic retinopathy with severe diabetic macular edema



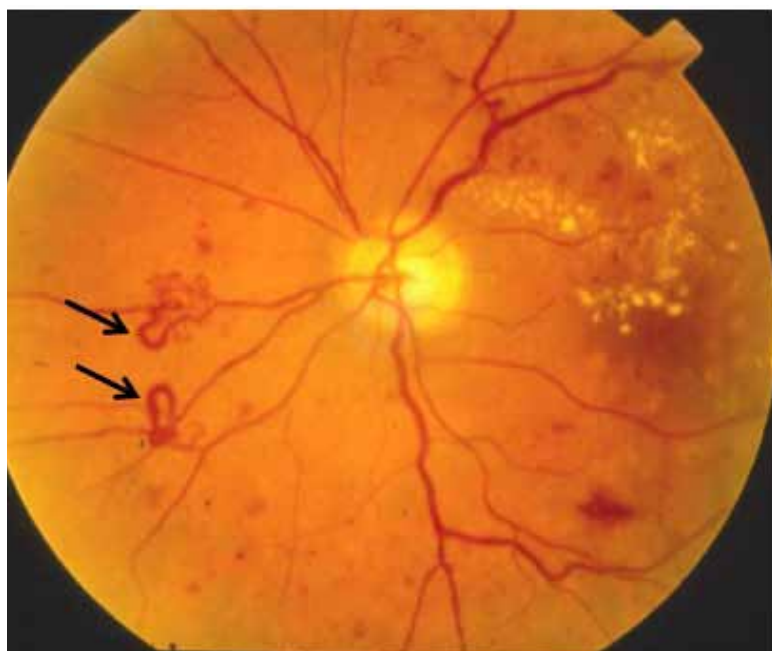
Moderate non proliferative diabetic retinopathy with no diabetic macular edema



Moderate non proliferative diabetic retinopathy with severe diabetic macular edema



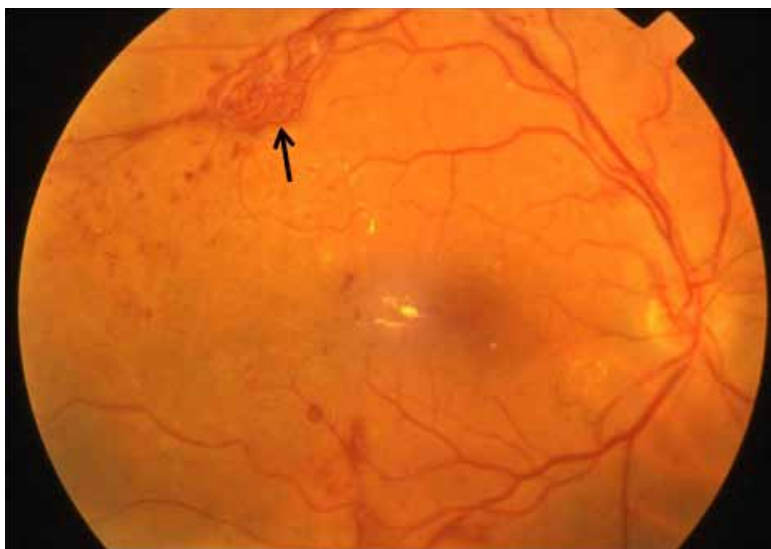
Severe non proliferative diabetic retinopathy with diabetic macular edema



Severe non proliferative diabetic retinopathy. Venous loops (arrows)



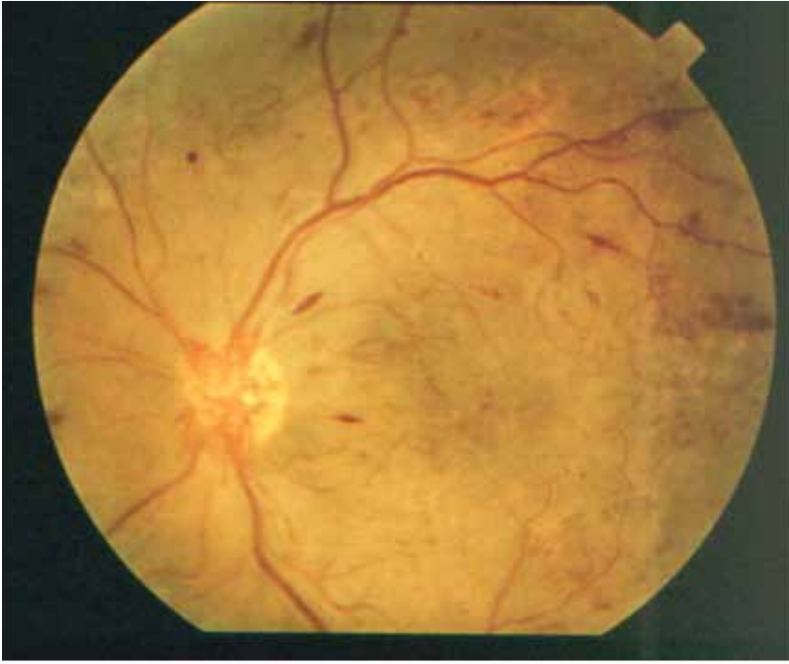
Severe non proliferative diabetic retinopathy. Venous beading (arrow)



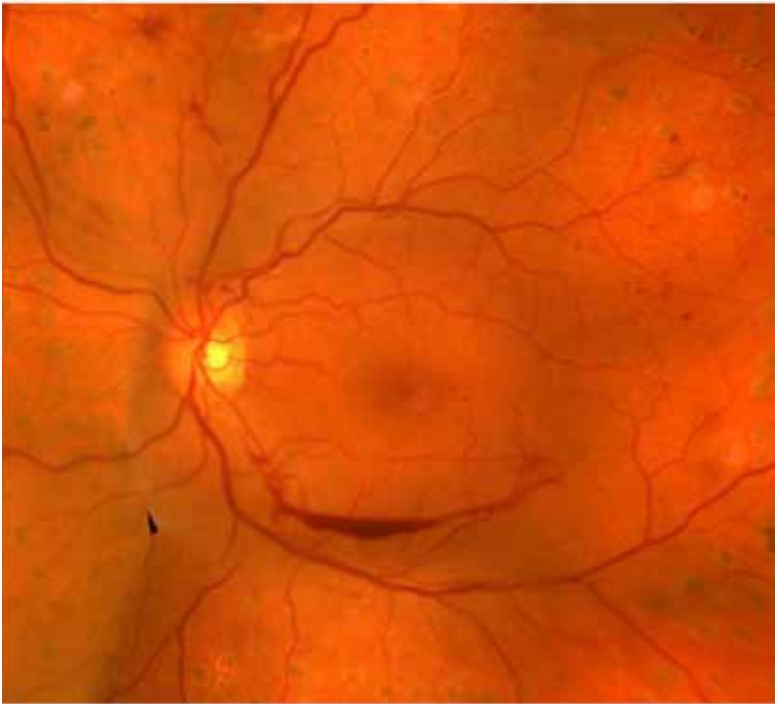
Proliferative diabetic retinopathy. Retinal new vessels elsewhere (arrow)



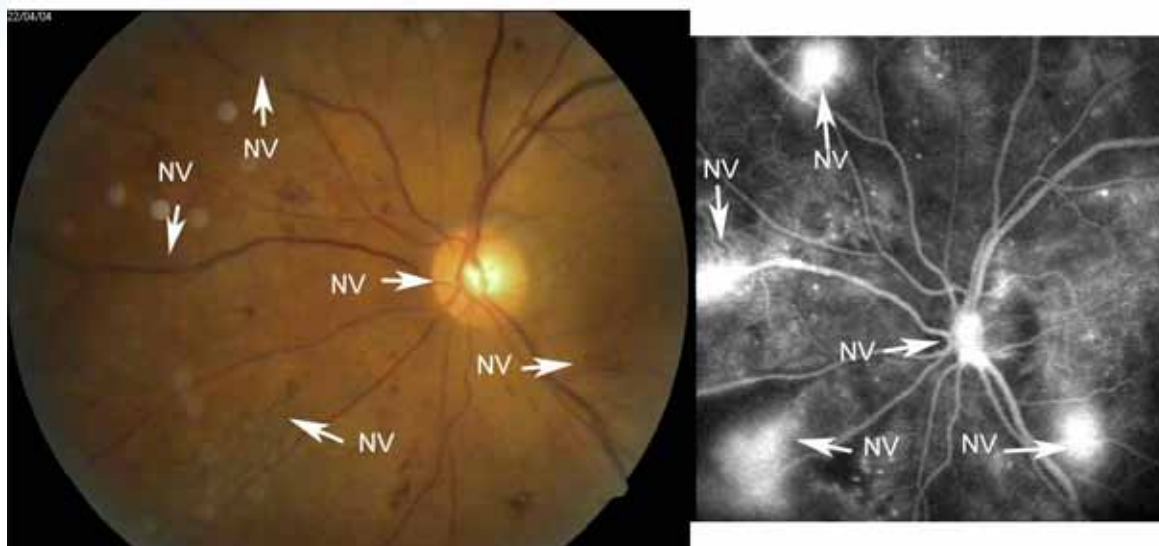
Severe non proliferative diabetic retinopathy. IRMA (black arrow) and venous duplication (white arrow)



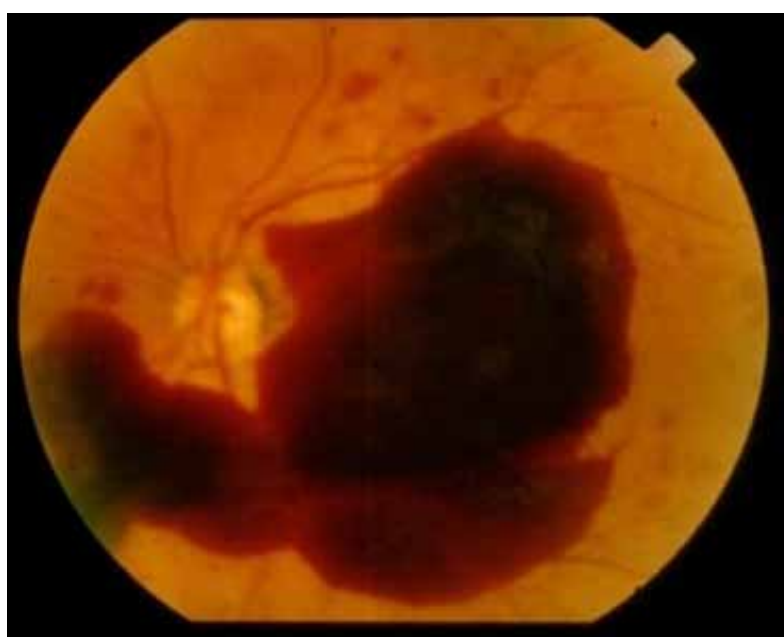
High risk proliferative diabetic retinopathy. New vessels disc



High risk proliferative diabetic retinopathy. Pre retinal hemorrhage, laser scars



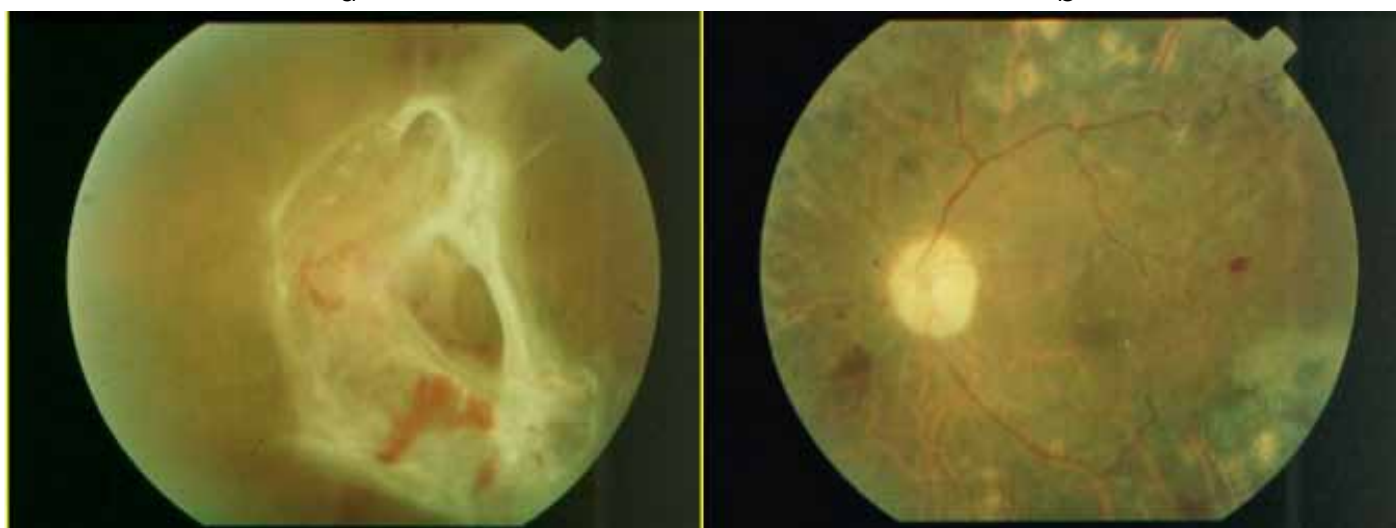
Proliferative diabetic retinopathy. New vessels on disc and elsewhere (Fluorescein angiography shows leakage)



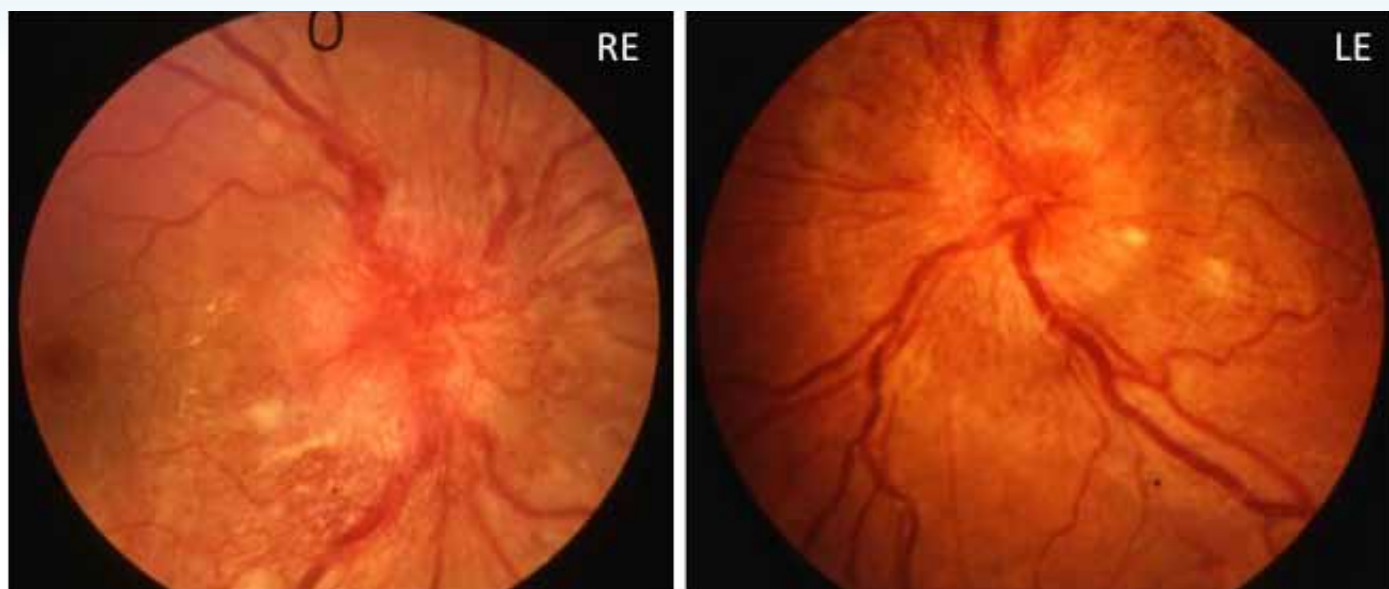
High risk proliferative diabetic retinopathy. Massive pre retinal hemorrhage.

a

b



Advanced proliferative diabetic retinopathy: fibrovascular proliferation. Before (1) and after (b) pars plana vitrectomy



Diabetic papillopathy



Panretinal (PRP) photocoagulation. First session: inferior retina (laser scars). Second session: superior retina (fresh burns). Third session will be needed to complete PRP

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