

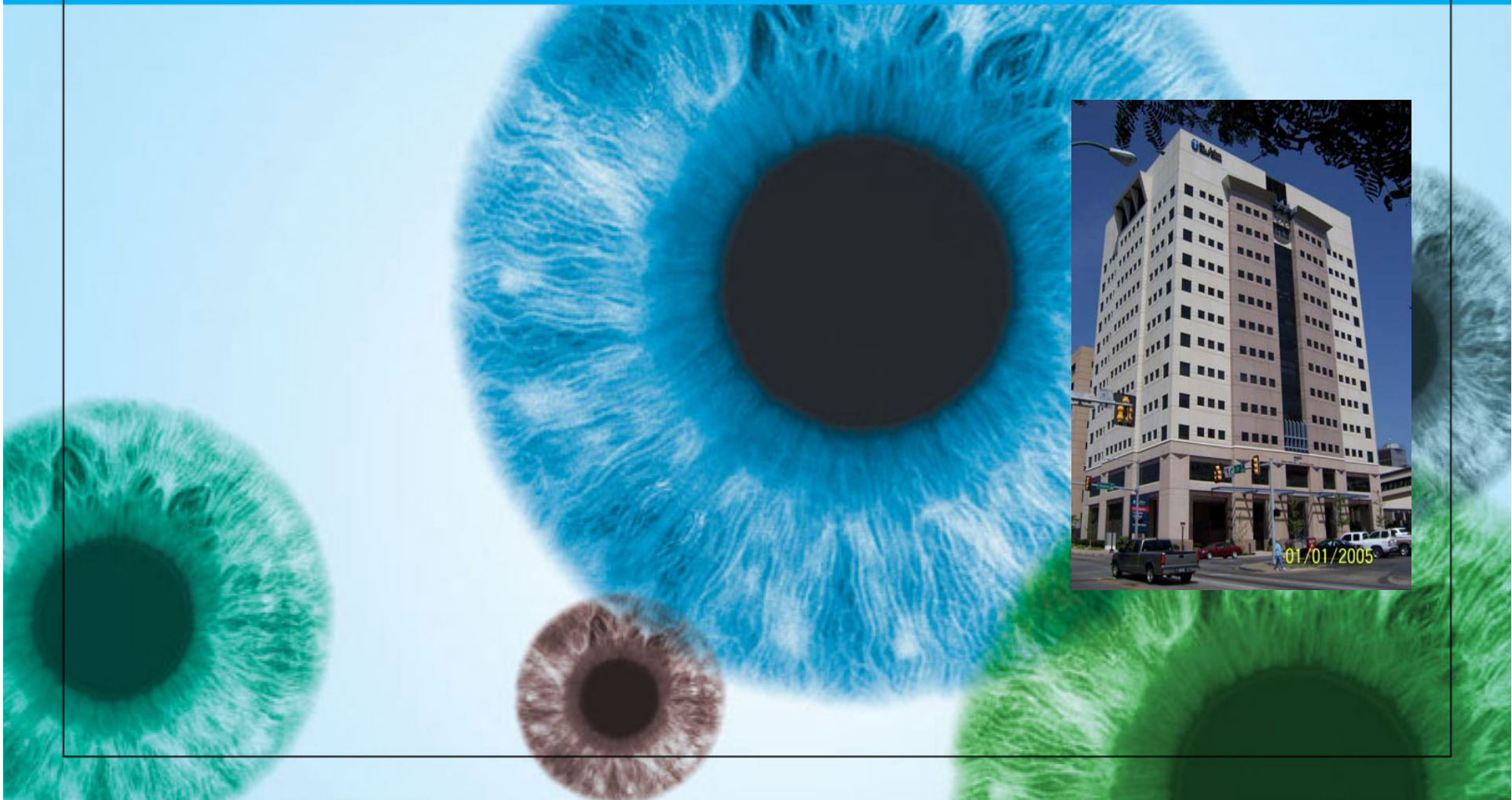
Diabetic Retinopathy

A Presentation for the Public

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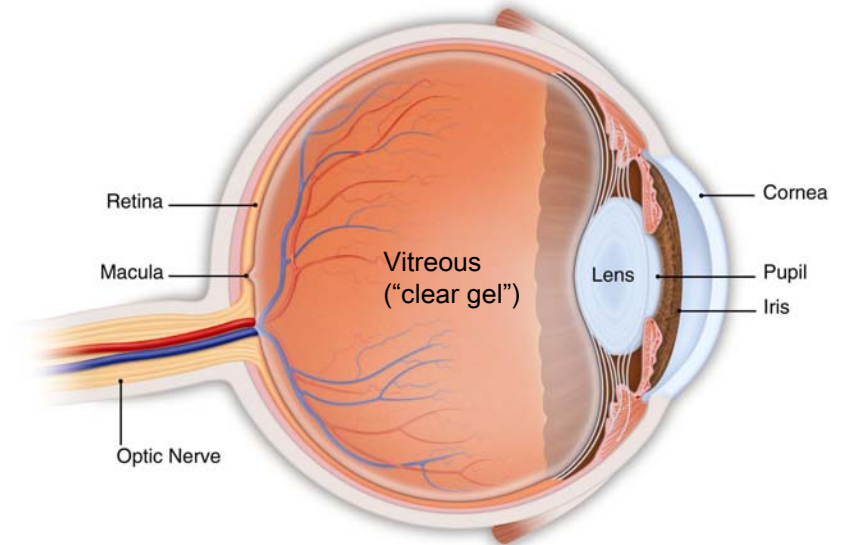
The Eye Institute

Tulsa, Oklahoma



The Healthy Eye

- Light rays enter the eye through the cornea, pupil and lens.
- These light rays are focused (*through the normally clear vitreous gel*) directly onto the retina, the light-sensitive tissue lining the interior of the eye.
- The retina converts light energy into (electrochemical) impulses sent through the optic nerve to the brain where they are recognized as images.



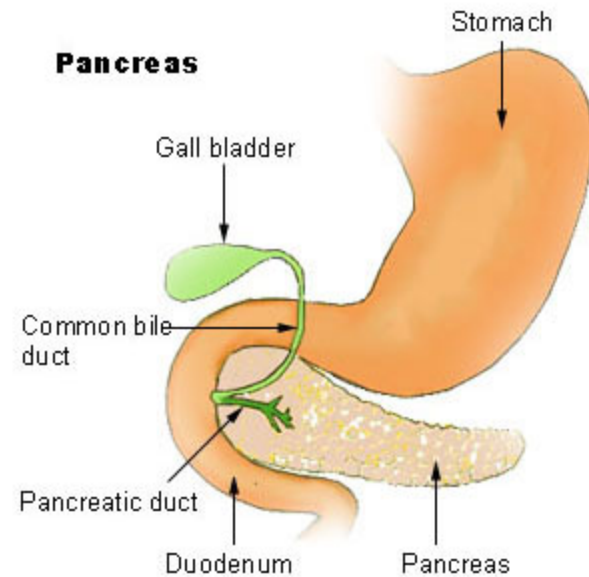
What is diabetes?

- **Diabetes mellitus is the inability of the body to use and store sugar properly, resulting in high blood glucose (sugar) levels.**

(Diabetes is caused by impaired insulin production from the pancreas and/or insulin resistance. Insulin resistance is the condition in which normal amounts of insulin are inadequate to produce a normal insulin response from fat, muscle and liver cells.)

Insulin resistance in fat cells results in elevation of fatty acids in the blood. Insulin resistance in muscle reduces glucose uptake whereas insulin resistance in liver reduces glucose storage, with both effects serving to elevate blood glucose.)

- **Diabetes results in damage to veins, arteries and capillaries throughout the body.**



How does diabetes affect vision?

- **Increases the likelihood of cataracts (clouding of the naturally clear lens in the eye).**
- **Increases the risk glaucoma (a disease of the optic nerve) especially “neovascular” glaucoma.**
- **Risk of developing diabetic retinopathy: damage occurs to the fragile blood vessels of the retina (the light sensitive inner lining of the eye).**

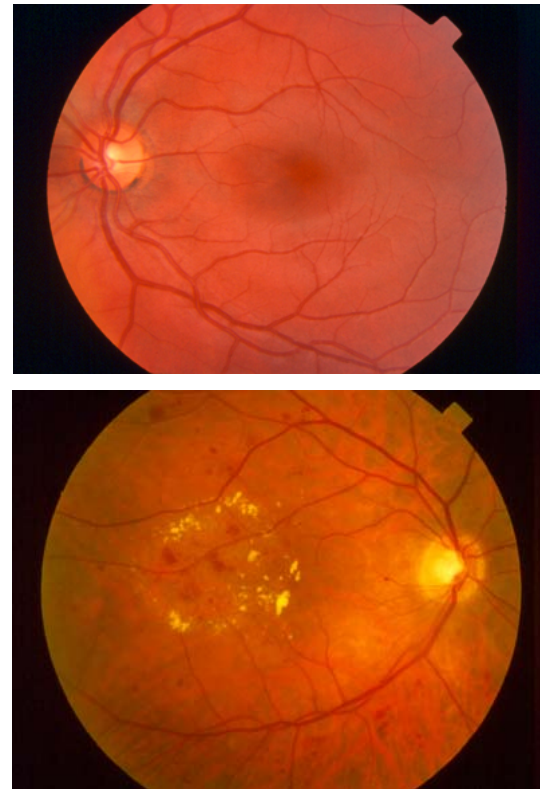
Diabetic retinopathy

Two types of diabetic retinopathy:

- **Nonproliferative diabetic retinopathy (NPDR)**
 - Early stage diabetic retinopathy
- **Proliferative diabetic retinopathy (PDR)**
 - Later stage diabetic retinopathy

Nonproliferative diabetic retinopathy (NPDR)

- also called “background” diabetic retinopathy
- earliest stage of diabetic retinopathy
- Damaged blood vessels leak fluid (from blood plasma) and small amounts of red blood cells into the retina.
- Cholesterol, triglycerides, and proteins from blood may leak into the retina forming “hard exudates”.



Top: healthy retina

Bottom: retina with NPDR,
containing “hard exudates”

Nonproliferative diabetic retinopathy

With NPDR, your central vision is affected by any of the following:

- **cholesterol and protein deposits in the central retina (macula)**
- **microaneurysms (small bulges in blood vessels (capillaries) of the retina that may “leak”)**
- **retinal hemorrhages (tiny spots of blood that may form in the central macula)**
- **macular edema (swelling/thickening of macula)**
- **macular ischemia (closing of small blood vessels (capillaries)).**

Nonproliferative diabetic retinopathy

Macular edema:

- **Macula thickens or swells, affecting vision.**
- **It is the most common cause of vision loss in diabetics.**
- **Vision loss may be mild to severe.**
- **Peripheral (side) vision is unaffected.**
- **Laser treatment may help to stabilize vision.**

Nonproliferative diabetic retinopathy

Macular ischemia:

- **Small blood vessels, or capillaries, close, blurring vision.**
- **Macula no longer receives enough blood to work properly.**
- **Currently no effective treatment for macular ischemia.**

Proliferative diabetic retinopathy (PDR)

- Later stage of diabetic retinopathy
- Abnormal blood vessels begin to grow on surface of retina or optic nerve (neovascularization); they do not provide retina with normal blood flow. As these vessels grow, scar-like tissue (fibrovascular proliferation) develops which can lead to (tractional) retinal detachment.

Top: healthy retina

Middle: retina with PDR and neovascularization

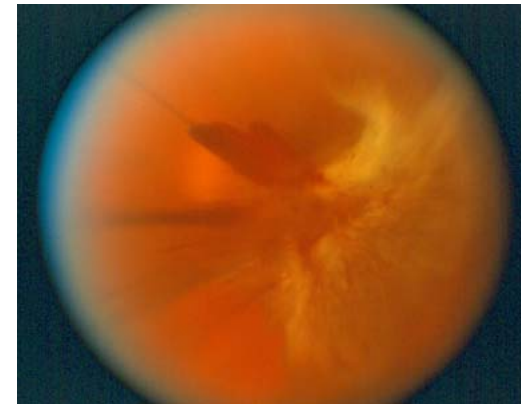
Bottom: retina with PDR and traction retinal detachment



Proliferative diabetic retinopathy

With PDR, vision is affected when any of the following occur:

- Vitreous hemorrhage (new abnormal blood vessels bleed into the vitreous gel, preventing light rays from reaching the retina).
- Traction retinal detachment (new abnormal blood vessels mature into scar-like membranes and tug on the retina potentially leading to retina detachment).
- Neovascular glaucoma (neovascularization occurs in the iris and nearby structures causing pressure to build up in the eye which may damage the optic nerve).



vitreous hemorrhage

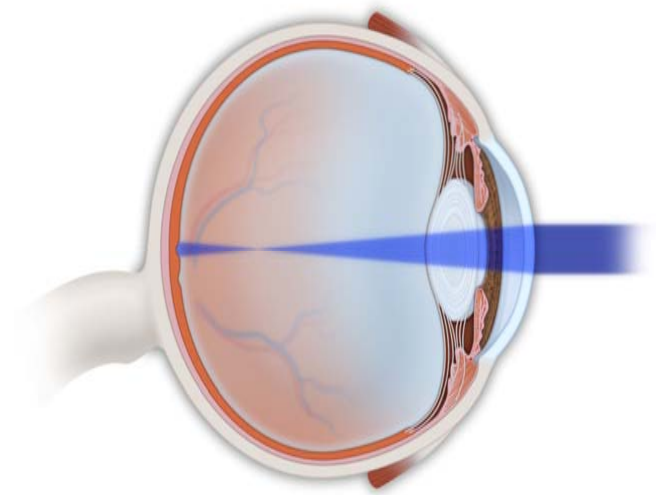
Diagnosing diabetic retinopathy

- **Diabetes can cause vision in both eyes to change, even if you do not have retinopathy.**
- **Rapid changes in your blood sugar alter the shape of the lens of the eye; the image on the retina will become out of focus.**
- **You can reduce episodes of blurred vision by maintaining good control of your blood sugar.**



Diagnosing diabetic retinopathy

- **People with diabetes should see their ophthalmologist immediately if they have visual changes that:**
 - affect only one eye
 - last more than a few days
 - are not associated with a change in blood sugar.
- **Ideally, your blood sugar levels should be consistently controlled for several weeks prior to seeing your ophthalmologist for an exam.**
 - Erratic blood sugar control causes a change in the focusing power of the eye, interfering with eyeglasses prescription measurements.



When to schedule an eye exam

- **If you were 30 years old or younger when your diabetes was first detected, you should have your first eye exam within five years after that diagnosis.**
- **If you were 30 years old or older, your first exam should be within a few months of the diabetes diagnosis.**
- **If you are pregnant, you should have an exam within the first trimester.**
- **If you already have experienced a high-risk condition, such as kidney failure or amputation related to diabetes, schedule an eye exam immediately.**

What happens during an eye exam

- Your ophthalmologist will dilate your pupils and examine your retina with special instruments using bright lights.
- **Fluorescein angiography: a diagnostic procedure using a special camera to take photographs of the retina after a small amount of water soluble dye (fluorescein) is injected into a vein in your arm.**
- **The photographs of fluorescein dye traveling throughout the retinal vessels show:**
 - which blood vessels are leaking
 - the severity of the leakage
 - which blood vessels are closed
 - whether or not neovascularization is present



fluorescein angiogram

What happens during an eye exam

Fluorescein angiography helps the ophthalmologist determine:

- **Why vision is blurred.**
- **Whether or not laser treatment should be started.**
- **Where to apply laser treatment.**
- **How effective laser treatment may be.**



What happens during an eye exam

Optical Coherence Tomography (OCT)

- OCT is a diagnostic tool for diseases of the macula (central retina) and optic nerve.
- OCT uses non-invasive coherent light (in which the electromagnetic waves maintain a fixed phase relationship with each other) to create a microscopic cross sectional image of the macula and optic nervehead capable of resolution to between 8 and 10 microns.
- In diabetics, OCT can “map” areas of macular edema (“swelling”) thus facilitating fluorescein angiography in guiding laser treatment of the macula. Repeat OCT studies may assist the ophthalmologist in assessing response to treatment and recurrence of macular edema.



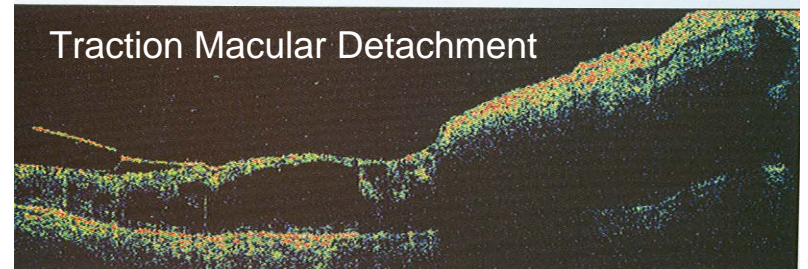
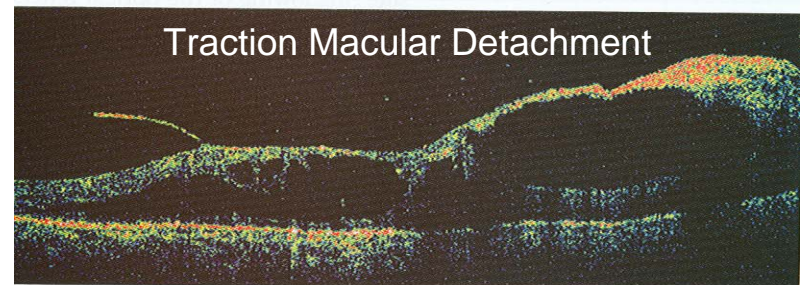
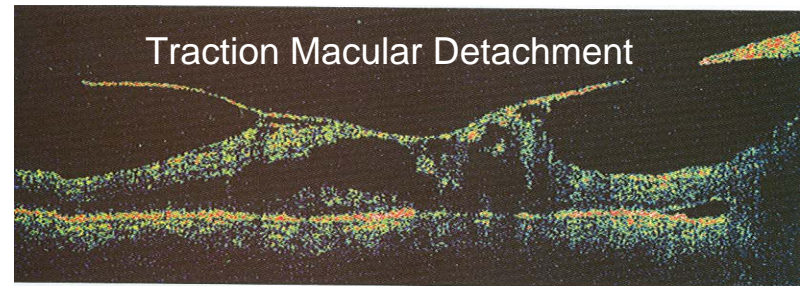
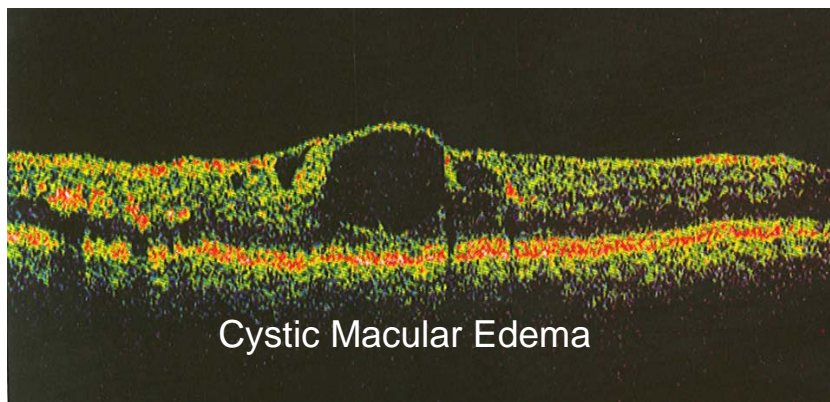
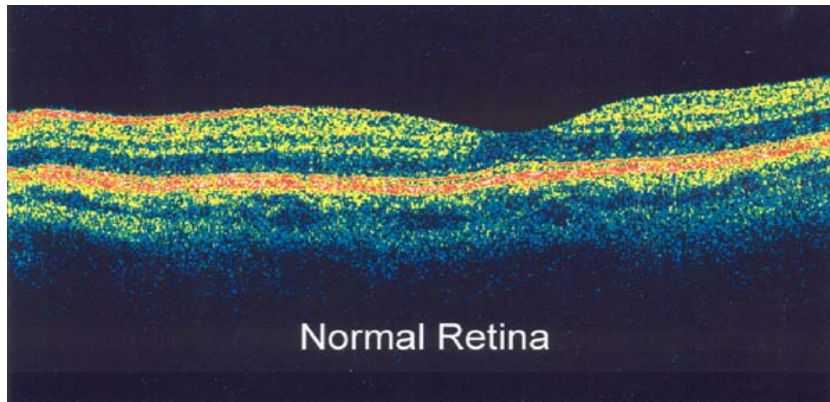


**See What
Lies Beneath.**

Optical Coherence Tomography

What happens during an eye exam

OCT



What happens during an eye exam

Ultrasound

- If your ophthalmologist cannot see the retina because of a vitreous hemorrhage, an ultrasound test may be done in the office.
- The ultrasound “sees” through the blood to determine if your retina has detached.
- If retinal detachment is present, especially near the macula, surgery may be necessary.
- After evaluation, your ophthalmologist will decide when you need to be treated or re-examined.



**vitreous hemorrhage with
retinal detachment**

Treating diabetic retinopathy

- **“An ounce of prevention is worth a pound of cure”.**
- **Strict control of your blood sugar will significantly reduce the long-term risk of vision loss from diabetic retinopathy.**
- **Laser treatment (photocoagulation) is often recommended for people with macular edema, PDR, and neovascular glaucoma.**

Diabetes Control and Complications Trial (DCCT)

- **The DCCT: a clinical study (1983 to 1993--1,441 volunteers with type 1 diabetes in the USA and Canada. Volunteers had diabetes between 1 and 15 years known duration. They also were required to have no, or only early signs of diabetic eye disease.**
- **The DCCT compared the effects of two treatment regimens—standard therapy and intensive control—on the complications of diabetes. Volunteers were randomly assigned to each treatment group**
- **Study results showed that intensive therapy reduced the risk for developing retinopathy by 76 percent. In participants with some eye damage at the beginning of the study, intensive management slowed the progression of the disease by 54 percent. Similar results were identified for the progression of diabetic kidney and peripheral nerve disease.**

United Kingdom Prospective Diabetes Study (UKPDS)

- **The UKPDS, the largest clinical study of diabetes ever attempted, has shown for the first time that the life-threatening complications of type 2 (non-insulin dependent) diabetes, often regarded as inevitable, can be reduced by more intensive management. The 20-year study recruited over 5,000 patients with type 2 diabetes in England, Northern Ireland and Scotland.**
- **The UKPDS has revealed that better blood glucose control reduces the risk of**
 - diabetic retinopathy & cataract by 25%
 - early kidney disease by 30-35%.
- **The UKPDS has also demonstrated that better blood pressure control (in the many patients who have high BP) reduces the risk of:**
 - serious deterioration of vision by more than a third,
 - death from long-term complications of diabetes by a third,
 - strokes by more than a third.

Treating diabetic retinopathy

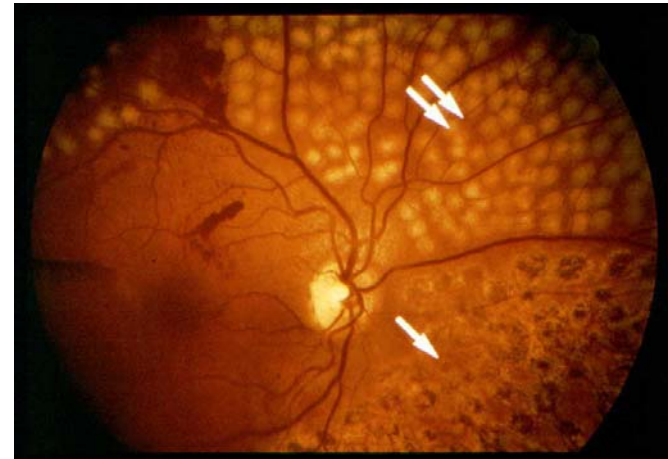
Laser surgery for macular edema

- **Low energy laser is focused onto microaneurysms in the macula to decrease leakage.**
- **Patients may see laser spots near the center of their vision following treatment; usually fade with time, but may not entirely disappear.**
- **Uncommon for people who have blurred vision from macular edema to recover normal vision, although some may experience partial improvement.**
- **Main goal of treatment: prevent further loss of vision.**

Treating diabetic retinopathy

Laser surgery for PDR (Proliferative Diabetic Retinopathy)

- Laser is focused on all parts of the retina except the macula.
- This “panretinal” photocoagulation treatment causes abnormal new vessels (neovascularization) to shrink; often prevents them from recurring.
- Treatment decreases the chance that vitreous bleeding or retinal detachment will occur.
- Multiple laser treatments over time are usually necessary.



laser panretinal
photocoagulation treatment
(arrows show laser spots on
the retina)

Drug Therapy for Diabetic Retinopathy

- **Tight control of diabetes with oral medications and/or insulin is paramount as demonstrated by the DCCT (type 1 diabetes) and UKPDS (type 2 diabetes).**
- **Oral ruboxistaurin has been shown in a recent 36 month study to lower the risk of loss of vision from macular edema in patients with pre-existing retinopathy. Ruboxistaurin lowers the level of protein kinase C and vascular endothelial growth factor (VEGF) thus reducing leakage from diabetic injured retinal blood vessels. This drug is NOT yet FDA approved.**

Drug Therapy for Diabetic Retinopathy

Intravitreal (“inside the eye”) drug injections:

- triamcinolone (a corticosteroid; mechanism of action unclear)
- Macugen, Lucentis, & Avastin (drugs primarily used to manage neovascular (“wet”) age-related macular degeneration (reduction in the severity of retinopathy by inhibiting VEGF). Macugen & Lucentis are FDA approved to treat “wet” AMD; none of these medications are yet FDA approved to treat diabetic retinopathy.
- Intravitreal drug injections are usually performed with laser procedures in order to enhance response to treatment.

Treating diabetic retinopathy

Vitrectomy surgery for advanced PDR (Proliferative Diabetic Retinopathy)



- **Indications: vitreous hemorrhage (clear, gel-like substance in middle of eye) fills with non-clearing blood and traction retinal detachment.**
- **Performed in the operating room, this microsurgical procedure involves removing the blood-filled vitreous and removal of neovascular (new vessel) membranes (fibrovascular proliferation)**
- **Improves vision by re-establishing clear vitreous fluids and lowers the probability of future bleeding by removing the neovascular membranes.**
- **Removal of scar-like (fibrovascular) membranes results in retinal reattachment and possible improvement in vision.**

Diabetic retinopathy is controllable

- You can significantly lower your risk of vision loss by maintaining strict control of your blood sugar level.
- Treatment does not cure diabetic retinopathy but it is effective in retarding vision loss and may, at least temporarily, improve vision.
- Most people with diabetes retain functional or near functional vision; total blindness is very uncommon if retinopathy is treated.
- Regular visits to your ophthalmologist (Eye M.D.) will help prevent unnecessary vision loss.

