DRIVING CHANGE
& INNOVATION

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Diabetes and the Eye

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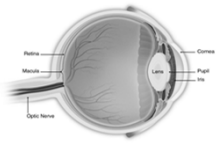
The healthy eye

- Light rays enter the eye through the cornea, pupil and lens
- These light rays are focused directly onto the retina, the light-sensitive tissue lining the back of the eye
- The retina converts light rays into impulses; sent through the optic nerve to your brain, where they are recognized as images



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What is diabetes?

- Diabetes Mellitus is the inability of the body to use and store sugar properly, resulting in high blood sugar levels
- Results in changes in veins, arteries and capillaries in the body

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How does diabetes affect vision?

- Could develop cataracts (clouding of the naturally clear lens in the eye)
- May develop glaucoma (a disease of the optic nerve)
- Risk of developing **diabetic retinopathy**: damage occurs to the fragile blood vessels inside the retina

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Prevent Blindness America (2012) Diabetic Retinopathy

- Prevalence %: 5.4%
- 7.7 million adults age 40 and over
- Population ≥ age 40: 143 million

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Diabetic retinopathy

Two types of diabetic retinopathy:

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

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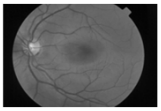
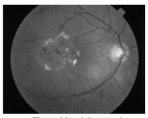
Nonproliferative diabetic retinopathy (NPDR)

- Also called background diabetic retinopathy
- Earliest stage of diabetic retinopathy
- Damaged blood vessels in the retina leak fluid and small amounts of blood into the eye
- Cholesterol or other fat deposits from blood, called hard exudates, may leak into retina





Top: Healthy retina
Bottom: Retina with NPDR, containing hard exudates

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Nonproliferative diabetic retinopathy

Central vision may be affected by:

- **Hard exudates** on the central retina (macula)
- **Microaneurysms** (small bulges in blood vessels of the retina that often leak fluid)
- **Retinal hemorrhages** (tiny spots of blood that leak into the retina)
- **Macular edema** (swelling/thickening of macula)
- **Macular ischemia** (closing of small blood vessels/capillaries)

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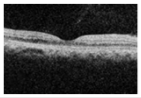
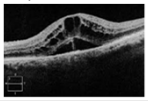
Nonproliferative diabetic retinopathy

Macular edema

- Macula thickens or swells, affecting vision
- Most common cause of vision loss in diabetes
- Vision loss may be mild to severe
- Peripheral (side) vision remains
- Laser treatment or injections may help to stabilize vision





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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

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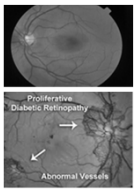
Proliferative diabetic retinopathy (PDR)

- Later stages of diabetic retinopathy
- Abnormal blood vessels begin to grow on surface of retina or optic nerve; can't provide retina with normal blood flow (neovascularization)
- PDR can cause severe visual loss and other serious complications, such as neovascular glaucoma and loss of the eye



Top: Healthy retina
Bottom: Retina with PDR and neovascularization

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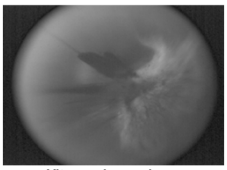
Proliferative diabetic retinopathy

- **Vitreous hemorrhage** (new, abnormal blood vessels bleed into vitreous gel in center of eye)
- **Traction retinal detachment** (new, abnormal blood vessels begin to shrink and tug on retina)
- **Neovascular glaucoma** (neovascularization occurs in the iris, causing pressure to build up in the eye, damaging the optic nerve)



Vitreous hemorrhage

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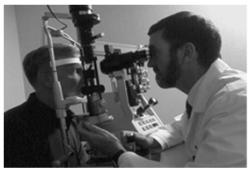
Diagnosing diabetic retinopathy

- Diabetes can cause vision in both eyes to change, even without retinopathy
- Rapid changes in blood sugar alter the shape of the eye's lens, and the image on the retina will become out of focus
- Episodes of blurred vision decreased by maintaining good control of the blood sugar



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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
- It is important that blood sugar be consistently controlled for several days prior to seeing an ophthalmologist for an exam
  - Uneven blood sugar causes a change in the eye's focusing power, interfering with the ophthalmologist's measurements

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When to schedule an eye exam

- If 30 years old or younger when diabetes was first detected, have an eye exam within five years after that diagnosis
- If 30 years old or older, first exam should be within a few months of the diabetes diagnosis, then annually
- If pregnant, should have an exam within the first trimester
- If there is a high-risk condition, such as kidney failure or amputation related to diabetes, schedule an eye exam immediately

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What happens during an eye exam

- The ophthalmologist will dilate the pupils and examine the retina with special instruments using bright lights
- Fluorescein angiography/OCT: diagnostic procedures to help visualize the retina and retinal circulation
- The testing will help identify:
  - Which blood vessels are leaking fluid
  - How much fluid is leaking
  - How many blood vessels are closed
  - Whether neovascularization is beginning

Fluorescein angiogram

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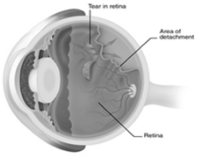
What happens during an eye exam

Ultrasound

- If the ophthalmologist cannot see the retina because of 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 there is detachment prompt surgery may be necessary



Retinal detachment

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Treating diabetic retinopathy

- Best treatment is to **prevent** development of retinopathy as much as possible
- **Strict control** of blood sugar will significantly reduce the long-term risk of vision loss from diabetic retinopathy (HbA1c of 7.0%, or 6.5% in some studies)
- Laser surgery or injections are often recommended for macular edema, PDR, and neovascular glaucoma

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ACCORD/ACCORDION

- NIH supported, ACCORDION reported in 2016
- Landmark ACCORD study (2003-2009): Type 2 diabetics randomized to intensive or standard treatment for glycemia (<6.0%), SBP (<120), and dyslipidemia (finofibrate or placebo + simvastatin)
- Retinopathy progression reduced by 1/3rd!
- Failed to reduce CVD risk however (seemed to increase)

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ACCORDION

- Action to Control Cardiovascular Risk in Daibetes Trial Eye Study
- Re-assessed DR 4 years after the intensive glycemic control arm had ended
- Risk of DR reduced by 50%!
- Well controlled glycemia had a measurable long term positive impact…..metabolic memory or legacy effect…..

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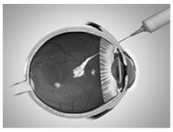
Treating diabetic retinopathy

- Anti-VEGF injections are becoming the preferred initial treatment for diabetic macular edema (corticosteroids also an option), and for proliferative retinopathy
- Laser treatment considered subsequently or deferred



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Treating diabetic retinopathy

Laser surgery for macular edema

- Laser is focused on the damaged retina near the macula to decrease fluid leakage
- Some may see laser spots near the center of their vision following treatment; usually fade with time, but may not 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

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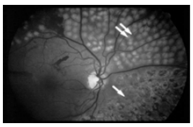
Treating diabetic retinopathy

Laser surgery for PDR

- Laser to the retina except the macula
- This "panretinal" laser treatment causes abnormal new vessels to shrink
- Treatment decreases the chance of vitreous bleeding and retinal problems
- Multiple laser treatments over time are sometimes necessary



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

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Treating diabetic retinopathy

Vitrectomy surgery for advanced PDR
(Proliferative Diabetic Retinopathy)

- Occurs when the vitreous fills with blood
- Performed in the operating room, this microsurgical procedure involves removing the blood-filled vitreous and replacing it with a clear solution
- Often prevents further bleeding by treating the abnormal vessels that caused bleeding with laser

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Diabetic retinopathy is controllable

- Strict control of blood sugar level critical
- Treatment does not cure diabetic retinopathy but it is effective in preventing further vision loss or restoring vision
- Most people with diabetes can retain good eyesight; total blindness is very uncommon if retinopathy is treated

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