






Presented by: Ansel T. Johnson OD
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Innovative Technologies and cases in Optometry: Addressing Chronic Disease



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Financial Disclosures

- Consultant with LKC 
- Consultant with Adnexa Ocular Amniotic Membranes 
- Consultant with Sight Science 
- Member Board of Directors 
- Consultant with  Tarsus



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Adjunct Professor:

- Midwestern Chicago College of Optometry (Externship site)
- Kentucky College of Optometry – UPIKE (Externship site)
- New England College of Optometry (Externship site)
- Southern College of Optometry (Externship site)
- Indiana University School of Optometry (Externship site)

Additional Clinical Externship Site

- UAB College of Optometry

Medical Director – United Eye Care Providers

- Founder, CEO – Healthy Living With A Vision Foundation
• (A 501c3 Organization)



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Course Objectives

- Provide an overview of common systemic conditions seen in an optometrist office
- Provide ocular conditions associated with systemic conditions presents in this course
- Provide ocular conditions associated with some medications and treatments for systemic conditions presented
- Learn ophthalmic protocols recommended for evaluation of ophthalmic conditions for systemic conditions presented.
- Evaluated newer technologies utilized for ophthalmic evaluations for systemic conditions



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Obesity

- **Ocular Conditions:** Increased risk of diabetic retinopathy, cataracts, glaucoma
- **Latest Technology:** OCT, Visual Field Testing, Fundus Photography
- **Evaluation Techniques:** Regular dilated fundus exams, OCT for retinal health, and monitoring IOP for glaucoma



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Prevalence¹ of Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2020

Summary

- No state or territory had a prevalence of obesity less than 20%.
- 3 states (Colorado, Hawaii, Massachusetts) and the District of Columbia had a prevalence of obesity between 20% and <25%.
- 11 states had a prevalence of obesity between 25% and <30%.
- 20 states, Guam, and Puerto Rico had a prevalence of obesity between 30% and <35%.
- 16 states (Alabama, Arkansas, Delaware, Indiana, Iowa, Kansas, Kentucky, Louisiana, Michigan, Mississippi, Ohio, Oklahoma, South Carolina, Tennessee, Texas, and West Virginia) had a prevalence of obesity between 35% and <40%.
- No state had a prevalence of obesity of 40% or greater.

¹Prevalence estimates reflect BRFSS methodological changes started in 2011. These estimates should not be compared to prevalence estimates before 2011.

²<http://www.cdc.gov/obesity/data/prev-obesity-maps.html>



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Being Overweight Defined

- **Definition:** Being overweight refers to having more body weight than what is considered healthy for one's height.
- **Body Mass Index (BMI):** Typically defined as having a BMI between 25 and 29.9.
- **Adipose Tissue:** Increased but not necessarily excessive levels of adipose (fat) tissue.
- **Health Risks:** Associated with some health risks, including a higher risk of developing conditions like hypertension and high cholesterol.
- **Severity Levels:** Can vary in severity and health impact based on factors like muscle mass and overall health.
- **Prevalence:** More common than obesity and affects a significant portion of the population.
- **Management:** Often manageable through lifestyle changes, including diet and exercise.

Source: www.mayoclinic.org

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Obesity Defined

- **Definition:** Obesity is a complex disease involving having too much body fat. Obesity isn't just a cosmetic concern. It's a medical problem
- **Causes or Contributing factors:** results from inherited, physiological and environmental factors, combined with diet, physical activity and exercise choices.
- **Health Risks:** Associated with numerous health complications, including heart disease, diabetes, stroke, and certain types of cancer.
- **Severity Levels:** Often classified into different classes (e.g., Class I, II, III) based on BMI.
- **Epidemic:** Considered a global epidemic due to its prevalence and significant health impact.
- **Management:** Often requires medical intervention, such as dietary changes, exercise, medication, or surgery.

Source: www.mayoclinic.org

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Obesity Defined

- **BMI Range:** Obesity is generally defined as having a BMI of 30 or higher, while being overweight falls within the range of 25 to 29.9.
- **Health Risks:** Obesity is associated with a higher risk of severe health conditions compared to being overweight.
- **Management:** Obesity often requires more intensive medical management, whereas being overweight can often be addressed with lifestyle changes alone.
- **Epidemiology:** Obesity is considered a global epidemic, while being overweight is a prevalent issue but not as severe in terms of health risks.

Source: www.mayoclinic.org

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Medical Definition of Obesity

Obesity Defined - other concepts

Another method of obesity assessment

Measuring waist circumference

Classes of weight categories and three classes of obesity

- Underweight: Less than 18.5.
- Optimum range: 18.5 to 24.9.
- Overweight: 25 to 29.9.
- Class I obesity: BMI 30 to <35 kg/m².
- Class II obesity: BMI 35 to <40 kg/m².
- Class III obesity: BMI 40+ kg/m².
 - Often associated with other chronic health conditions
 - Formerly termed Morbid obesity with is an outdated label for class III obesity

Source: CDC.

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OBESITY HEALTH RISKS

Type 2 Diabetes

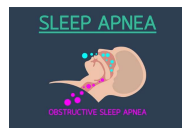


Cardiovascular Disease



Stroke

Cancer



OBSTRUCTIVE SLEEP APNEA

Source: aca.org Diabetes Standard of Care, https://doi.org/10.1007/978-3-030-54064-7_4-1

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Limitations of BMI as a Measure

- Bodybuilders and athletes,
- Higher muscle density
- Total body fat
- Possibility to have obesity at a "normal" weight.
- Average body weight
- Body fat percentage is high
- Same health risks as somebody with a higher BMI.

Source: CDC.

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Other Methods of Measuring Obesity

- **Waist Circumference:** Measuring the circumference of the waist can help assess central obesity, which is particularly associated with health risks. A waist circumference above certain thresholds is indicative of increased abdominal fat. 
- **Waist-to-Hip Ratio (WHR):** This ratio assesses the distribution of fat in the body. It involves measuring the waist circumference and dividing it by the hip circumference. Higher WHR values suggest central obesity and an increased risk of health problems. 
- **Skinfold Thickness:** Skinfold thickness measurements involve using calipers to measure the thickness of subcutaneous fat at various body sites. This can provide an estimate of overall body fat percentage. 

*Source: www.mayoclinic.org

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Other Methods of Measuring Obesity

- **Computed Tomography (CT) and Magnetic Resonance Imaging (MRI):** These imaging techniques can provide precise measurements of body fat distribution and visceral fat (fat around internal organs). They are often used in research and clinical settings.  
- **3D Body Scanning:** Advanced 3D body scanning technology can create detailed 3D models of an individual's body, allowing for precise measurements of body fat and its distribution. 
- These methods offer varying levels of accuracy and may be used in combination to provide a more comprehensive assessment of obesity and associated health risks. The choice of method often depends on the clinical context, resources available, and the specific information needed for a patient's care.


*Source: www.mayoclinic.org

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Don't Do It !!!!!



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Why Can't You Loose Weight?



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Causes of Obesity

- Fast and convenience foods
- Sugar is in everything.
- Marketing and advertising.
- Psychological factors
- Hormones
- Certain medications
- Screen culture
- Workforce changes
- Fatigue
- Neighborhood design
- Childcare trends
- Disability

Source: <https://www.cdc.gov/obesity/basics/causes.html>

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Systemic Conditions Associated with Obesity

- Coronary and congestive heart disease
- Pre-Diabetes
- Type 2 diabetes mellitus
- Hypertension
- Stroke
- Dyslipidemia
- Osteoarthritis
- Back pain
- Kidney Disease
- Sleep apnea
- Certain types of cancers. obesity is responsible for approximately 40% of endometrial cancers
 - 25% of renal cancers
 - 10% each of colonic and breast cancers
- Other obesity-associated co-morbidities
- Memory and cognition, including a heightened risk of Alzheimer's disease and dementia
- Female infertility and pregnancy complications, polycystic ovary syndrome, fatty liver disease
- Hypercoagulability disorders
- Depression secondary to social stigmatization and discrimination



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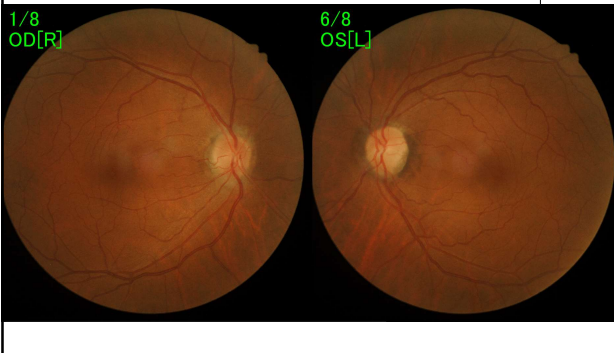
Case #1 – Obesity

- 51 year old African American Man
- Occupation – Truck Driver
- Gout
- Hypertension
- Family Hx – Diabetes / Hypertension
- Sleep apnea (CPAP)
- Height 6' 1"
- Weight 412 lbs
- BMI 54.4
- In office BP 154/76 pulse 86
- Scheduled for bariatric surgery (gastric sleeve)
- Systemic Meds: Allopurinol, amlodipine, lisinopril/triamterene



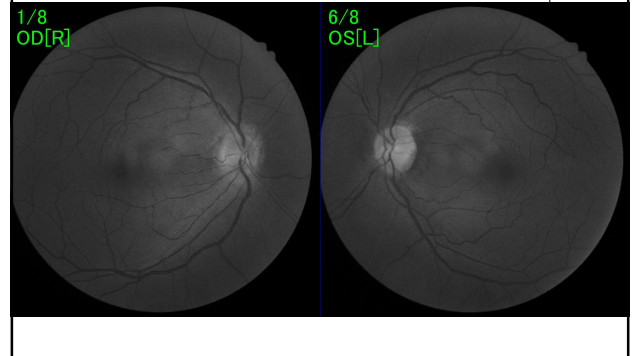
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Case #1 – Obesity



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Case #1 – Obesity



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Ocular Signs and Conditions Related to Obesity

- Dry eye
- Cataracts
- Glaucoma
- Age Related Maculopathy
- Diabetic Retinopathy
- Retinal vein occlusion
- Oculomotor nerve palsy.
- Recurrent lower eyelid entropion
- Papilledema / Pseudotumor
- Floppy eyelid syndrome
- Benign intracranial hypertension (pseudotumor cerebri).

Source: CDC.



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Limitations of BMI as a Measure

- Ethnic differences in BMI
- People of Asian descent are more likely to have health risks at a lower BMI
- Black people are more likely to have health risks at a higher BMI.

Source: CDC.

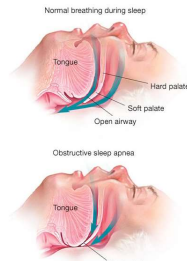


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Obesity & Sleep Apnea

- Sleep Apnea Results in 40% Greater Risk of Glaucoma

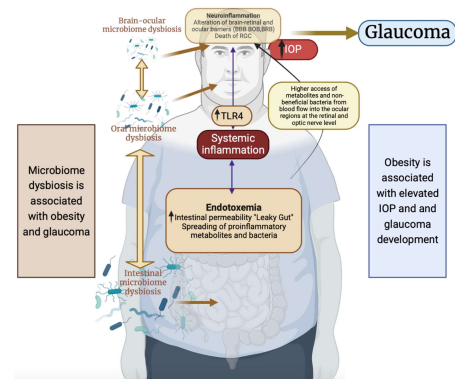
- The condition also affected nonglaucomatous eyes in terms of visual field defects, IOP and RNFL thickness.



Source: Review of Optometry March 31, 2023

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BMI & Glaucoma Risk



Source: Int. J. Mol. Sci. 2023, 24(2), 1166; <https://doi.org/10.3390/ijms24021166>; Published: 6 January 2023

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Patient 7: NB

A 56 y/o AA male presents to clinic for a medical f/u involving primary angle glaucoma OU.

Ht: 70in, Wt: 410lbs, BMI: 58.8

Medical history: Obesity

Medications: Latanoprost 0.005% QD OU and unspecified diet pill

Ocular history: Progressive spectacles

Allergies: n/a

Exam Findings:

Entering BCVAs- OD:20/20 OS:20/20

IOPs- OD: 7mmHg, OS: 8mmHg

Anterior segment findings: Trace NS and cortical cataracts OU

Posterior segment findings: OU- Glaucomatous cupping, nerve fiber layer defect, and enlarged C/D ratio. Irregular foveal avascular zone with mild capillary dropout.

Diagnosis: Primary Open Angle Glaucoma OU, Retinal nerve fiber bundle defects

Plan/Follow up: Return in 4 months for DFE, IOP check, automated perimetry, and OCT.

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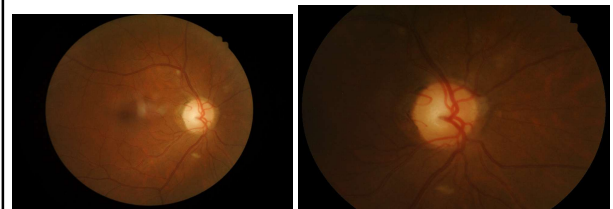
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Additional testing:

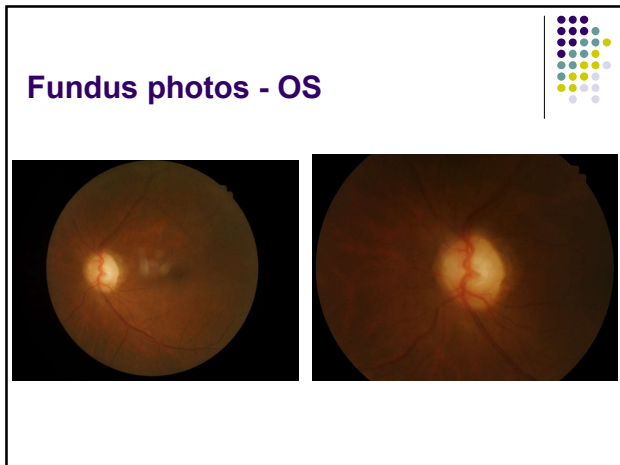


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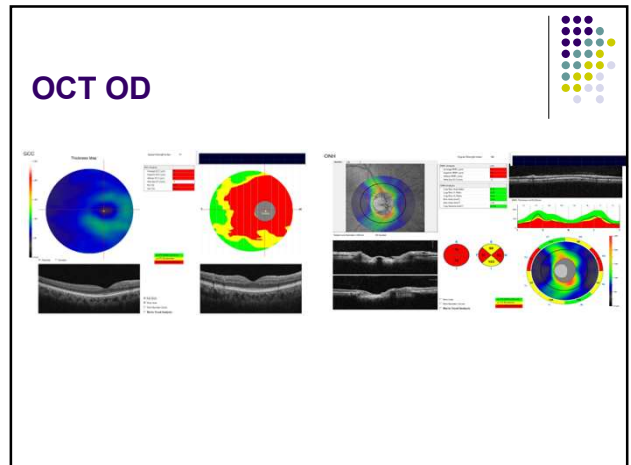
Fundus photos - OD



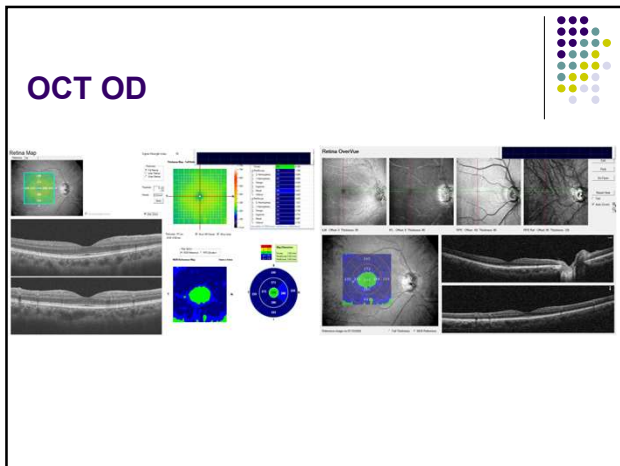
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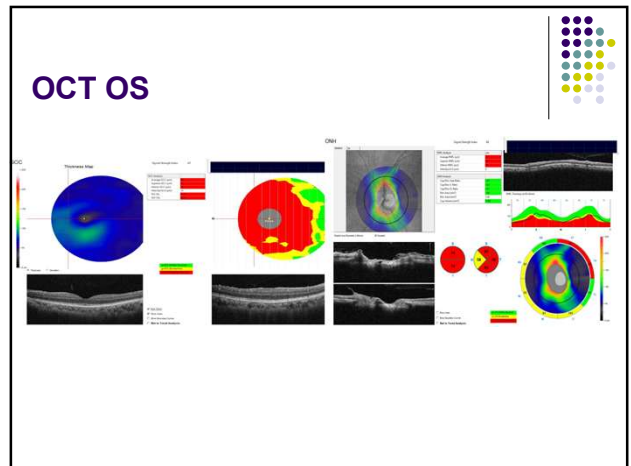
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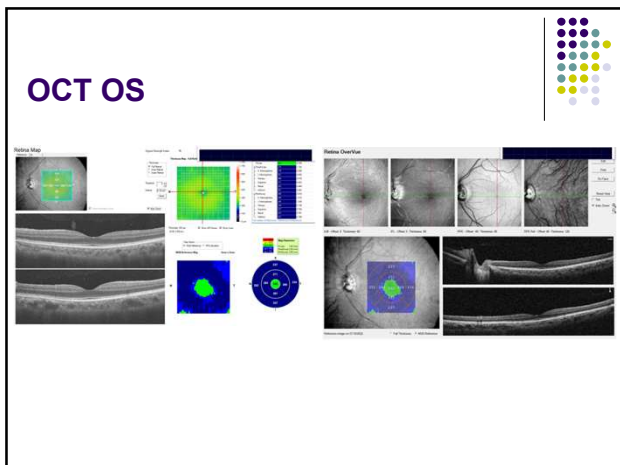
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Pre-Diabetes

Prevent Type 2 Diabetes

Talking to your patients about lifestyle change

Threat of Prediabetes

98 Million
About 98 million American adults—more than 1 in 3—have prediabetes

More than 8 in 10 adults with prediabetes don't know they have it

Prediabetes increases the risk of:

- Type 2 diabetes
- Heart Disease
- Stroke

If your patients have prediabetes, losing weight by...
Participation in a Lifestyle Change Program

Source: CDC

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Definitions & Statistics

Pre-Diabetes

•HbA1c of 5.7 to 6.4

•May also exhibit impaired glucose tolerance (IGT) or impaired fasting glucose (IFG).

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Pre-Diabetes

Pre Diabetes symptoms

- *Acanthosis nigricans* is a skin condition characterized by areas of dark, velvety discoloration in body folds and creases. The affected skin can become thickened



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Pre-Diabetes Lifestyle Change Program

The lifestyle change program that is part of the CDC-led National Diabetes Prevention Program is **proven to help prevent or delay type 2 diabetes**. It is based on research that showed:

- 58% lower incidence of type 2 diabetes **after weight loss of 5 to 7% of body weight** achieved by reducing calories and increasing physical activity to at least 150 minutes per week.
- 71% reduced incidence of type 2 diabetes **for people 60 and older**.
- 27% lower incidence of type 2 diabetes in lifestyle change program participants **after 15 years**.

*Source: CDC

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PREDIABETES

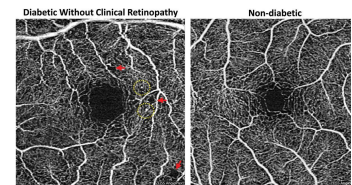
COULD IT BE YOU?



Retinal Signs

Wider Retinal Vein Caliber

- Linked to metabolic syndrome (Blue Mountains Study)
- Evidence is associated with various microvascular complications of diabetes including diabetic retinopathy and diabetic nephropathy
- **Conclusion:** literature is showing isolated signs of retinopathy in those without diabetes in those under 65 years and with a family history of diabetes are at a higher future diabetes risk



Source: <http://care.diabetesjournals.org/content/30/10/2708.full>
<https://www.reviewofoptometry.com/article/retinal-microcirculation-changes-found-in-prediabetes>

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PREDIABETES

COULD IT BE YOU?



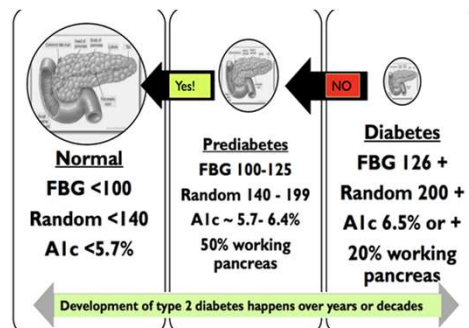
HbA1c of 5.7 to 6.4

Prediabetes reflects failing islet beta-cell compensation or an underlying state of insulin resistance, often caused by excess body weight or obesity.

Prediabetes is defined as an abnormal blood glucose level, an elevated A1c level, or an abnormal glucose tolerance test.

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Natural Progression of Diabetes over time



DiabetesEd.com, 2019

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Patient Centered Care

- Referral sources for patients living with obesity
- PCP, Family Practitioner
- Dieticians
- Mental health
- Podiatry
- Always patient centered
- Patient centered care defined

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CONSENSUS-BASED ACTION STATEMENT

CONSENSUS-BASED ACTION STATEMENT:

The initial ocular examination of a person with diabetes should include all aspects of a comprehensive eye and vision examination, with ancillary testing, as indicated to and thoroughly evaluate ocular complications of diabetes.

WIDE-FIELD
FUNDUS PHOTOGRAPHY



Source: aca.org Diabetes Standard of Care

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CONSENSUS-BASED ACTION STATEMENT

EVIDENCE-BASED ACTION STATEMENT:

The patient's primary care physician should be informed of eye examination results following each examination, even when retinopathy is minimal or not present.

Evidence Statements: Written communication between the eye care provider and a patient's primary care physician has been found to be associated with improved adherence to recommendations for follow-up diabetic eye examinations.²⁷⁴ (Evidence Grade: B)

Potential Benefits: Coordination of care Potential Risks/Harms: None

Benefit and Harm Assessment: Benefits significantly outweigh harms



Source: aca.org Diabetes Standard of Care

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Patient 1: NJ

33 y/o AA female presents to clinic on 8/10/2022 with chief complaint of redness OD. Associated symptoms included dryness and itchiness. Tried using Lumify with no improvement. Pt additionally noted headaches began occurring 2 weeks prior to today's visit.

Ht: 64in, Wt: 260lbs, BMI: 44.6

BP 109/82

Medical history: asthma

Medications: Phentermine 37.5mg (weight loss), Spironolactone 50mg

Ocular history: current single vision spectacles

Allergies: n/a

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Exam findings:

Entering BCVAs-

OD:20/25 OS:20/150.

IOPs- OD: 11mmHg, OS:8mmHg

Anterior segment findings: sub conjunctival hemorrhage OD

Posterior segment findings: blurred disc margins OU, obscuration of blood vessels, bilateral swollen discs, tortuous and dilated bilateral retinal veins. Chorioretinal macular scarring OS

Diagnosis: bilateral papilledema and chorioretinal macular scar OS.

Plan: Referred to hospital for immediate neuro workup.

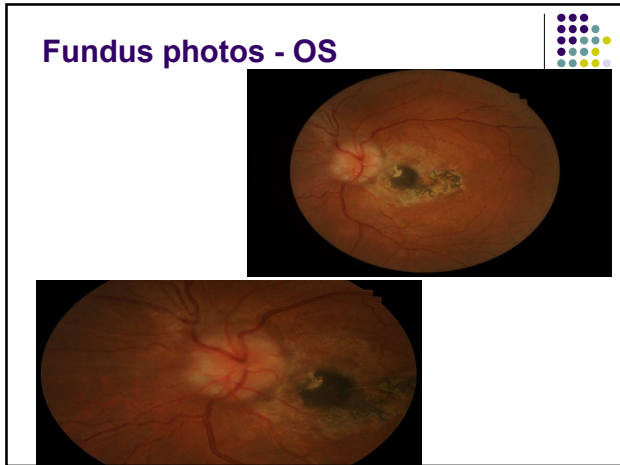
Follow up: called patient multiple times, but never heard back from her.

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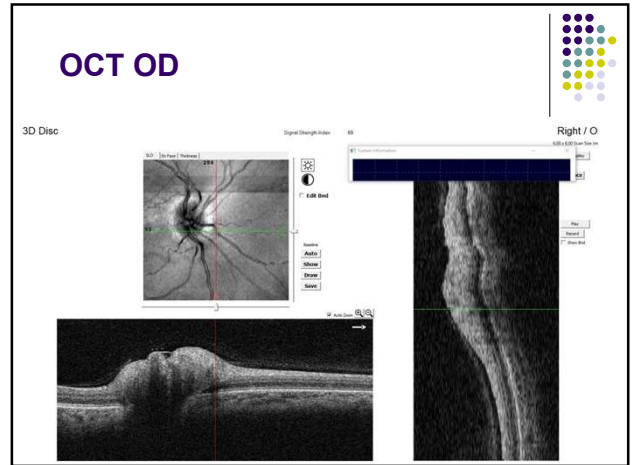
Fundus photos - OD



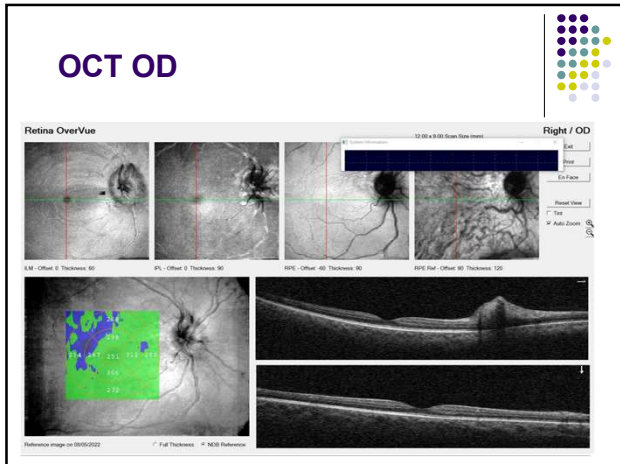
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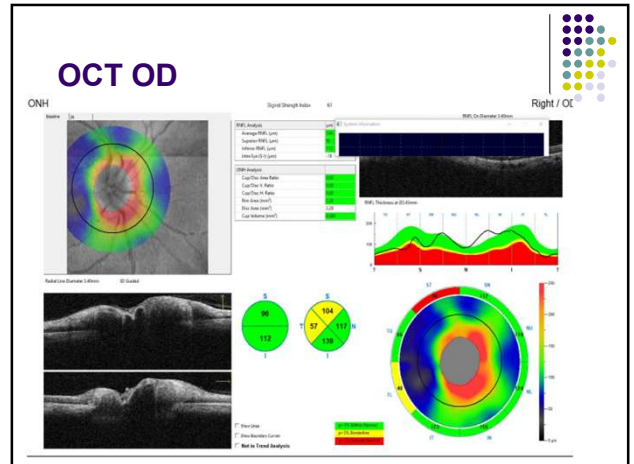
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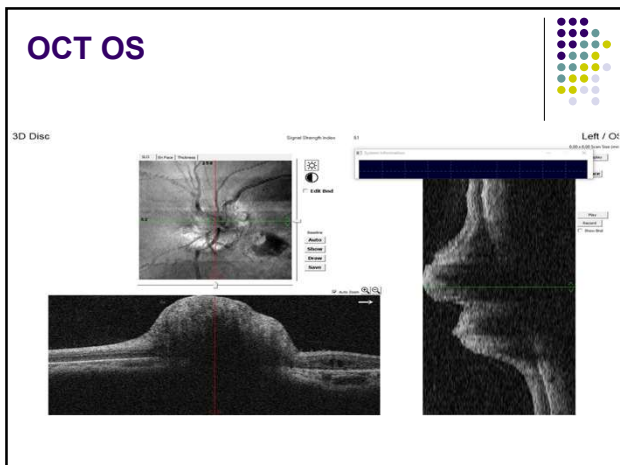
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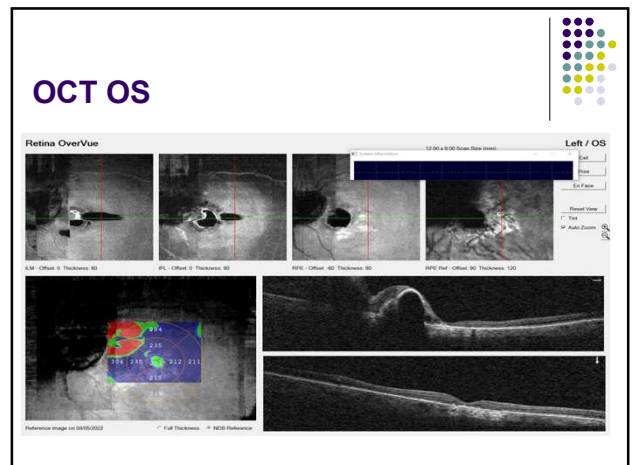
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ADA DIABETES
STANDARDS OF CARE



Glycemic Control Assessed By:

- A1C measurement
- Continuous glucose monitoring (CGM)
 - Time in range (TIR)
- Glucose management indicator (GMI)
- Blood glucose monitoring (BGM)

Source: Diabetes Care Volume 45, Supplement 1, January 2022

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ADA DIABETES
STANDARDS OF CARE



Utilization and Benefits of A1c Test

- Reflects average glycemia over approximately 3 months.(but not exactly)
- Test is a primary tool for assessing glycemic control
- Strong predictive value for diabetes complications
- Should be performed routinely in all patients with diabetes at initial assessment and as part of continuing care.

Source: Diabetes Care Volume 45, Supplement 1, January 2022

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American Diabetes Association
Connected for Life

Focus on Diabetes Pocket Guide

Guide to Clinical Eye Care for Patients with or at-risk for Diabetes

The American Diabetes Association® (ADA) has summarized key clinical recommendations for health care professionals on eye health management for people with or who are at-risk for diabetes.

Annual comprehensive eye exams play a crucial role in the early detection, intervention, and prevention of eye disease and vision loss caused by diabetes. Early detection, timely treatment, and appropriate follow-up care can reduce a person's risk for severe vision loss from diabetic eye disease by 95 percent*.

For those living with, or at risk for diabetes, an annual eye exam is a must – offering a simple and non-invasive way to prevent or delay disease and vision loss caused by diabetes. Diabetic eye disease is diagnosed through:

- Comprehensive and dilated exams which allow professionals to closely examine the retina.

Retinal photography and other imaging such as optical coherence tomography (OCT), which uses light waves to take pictures that show the retina's distinctive layers to detect macular edema, assess glaucoma, and monitor other eye conditions.

*Source: ADA

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A1c Test

An individual's A1C level, at initial examination, has been shown to be a strong predictor of the incidence and progression of any retinopathy or progression to proliferative retinopathy.

*Source: aoa.org Diabetes Standard of Care page 46

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CONSENSUS-BASED ACTION STATEMENT

CONSENSUS-BASED ACTION STATEMENT:

The initial ocular examination of a person with diabetes should include all aspects of a comprehensive eye and vision examination, with ancillary testing, as indicated to and thoroughly evaluate ocular complications of diabetes.

Source: aoa.org Diabetes Standard of Care

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CONSENSUS-BASED ACTION STATEMENT

EVIDENCE-BASED ACTION STATEMENT:

If ophthalmoscopy and/or optical coherence tomography (OCT) is used, fluorescein angiography (FA) is not needed to confirm a diagnosis of proliferative diabetic retinopathy (PDR) or to assess diabetic macular edema (DME).263,264

Evidence Statements: Fluorescein angiography is not indicated to confirm a suspected clinical diagnosis of PDR, as ophthalmoscopy has been proven to be comparable to FA.263 (Evidence Grade: B)
The use of FA for assessing DME is **not recommended**, since it offers little additional information beyond that provided by OCT imaging.264 (Evidence Grade: B)


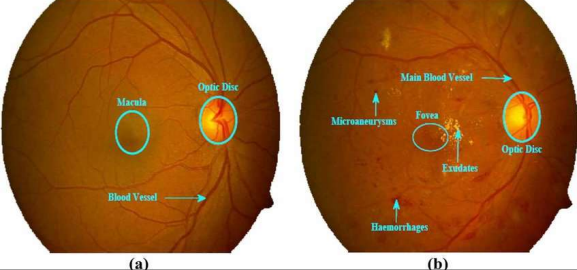
Potential Benefits: Avoidance of unnecessary testing and reduced risk of injection complications
Potential Risks/Harms: None
Benefit and Harm Assessment: Benefits significantly outweigh harms

Source: <https://www.opthalmologymanagement.com/ssues/2015/july-2015/learning-to-read-retinal-oct>

*ADAM
Source: <https://www.slideshare.net/rvrdad/fb-164759057>
Source: aoa.org Diabetes Standard of Care

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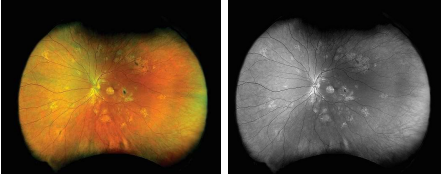
Digital Retinal Photography

(a) (b)

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Wide Field Retinal Imaging

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Continuous Glucose Monitors

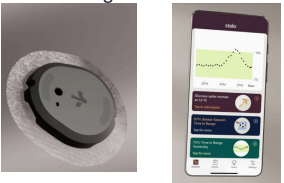


Source: <https://freestylediabetesme.com/freestyle-libre-system/>

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Over-The-Counter Continuous Glucose Monitors

- Continuous glucose monitoring (CGM) and glucose biosensors are both tools used to track your glucose levels.
- However, a prescription from a doctor is required for traditional CGMs
- The following devices are over the counter



Source: <https://www.stelo.com/>

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Over-The-Counter Continuous Glucose Monitors

Lingo CGM (Abbott)

Target Audience: Health-focused individuals without diabetes.
 Usage Duration: Worn for two weeks,
 App Features: Provides personalized insights and coaching recommendations to improve metabolic health.
 Purpose: Helps users understand how diet, exercise, sleep, and stress affect blood sugar.

Libre Rio CGM (Abbott)

Target Audience: Adults with type 2 diabetes who do not use insulin.
 Usage Duration: Worn for two weeks.
 App Features: Provides insights into blood sugar patterns to help manage diabetes through diet and physical activity.
 Purpose: Designed for people managing diabetes through lifestyle modifications.

Source: <https://www.stelo.com/>; <https://www.helloingo.com/>

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Over-The-Counter Continuous Glucose Monitors

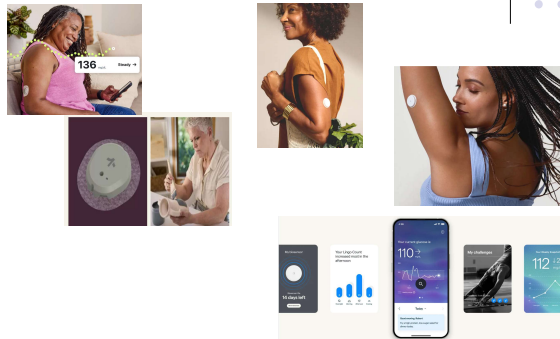
Stelo CGM (Dexcom)

Target Audience: General consumers, including those with prediabetes and type 2 diabetes.
 Hardware: Based on Dexcom G7 technology.
 Usage Duration: Worn for up to 15 days with 12 hour grace period.
 App Features: Restricted functionality compared to the prescription version.
 Purpose: Provides continuous glucose monitoring without the need for a prescription.

Source: <https://www.stelo.com/>; <https://www.helloingo.com/>

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Over-The-Counter Continuous Glucose Monitors



Source: <https://www.stelo.com/>, <https://www.helloingo.com/>

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A Few Common Ocular Complications Associated With Diabetes

Cataracts
Glaucoma
Accommodation or ocular motor dysfunction
Visual Field Defects
Color Vision Defects
Dry Eye
Diabetic retinopathy

Source: <https://www.cdc.gov/nchs/products/index.htm>

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Diabetes and Cataracts

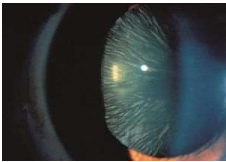
Free radical nitric oxide (NO•) is elevated in the lens and aqueous humor of diabetic patients. Can cause an increase in peroxynitrite formation, which contributes to cell damage due to oxidizing properties

Diabetic lenses have increased susceptibility to oxidative stress due to their impaired antioxidant capacity

8.3% of patients suffering from type 1 diabetes and **24.9%** of those with type 2 diabetes had a 10-year cumulative incidence of cataract surgery.

The duration and complexity of cataract surgery are the main risk factors for progression of retinopathy; therefore it is important to reduce the time and complexity of the surgery

Poor visual acuity following cataract extraction is still common in patients with DM. PCO, postoperative cystoid macular edema (CME), DME, and worsening of the DR are the main complications seen in diabetic patients



Source: <https://www.cdc.gov/nchs/products/index.htm>

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DIABETES AND GLAUCOMA

Researchers found that the age of Type 2 diabetes and/or hypertension diagnosis was significantly linked with the onset of POAG.

The earlier patients presented with either or both of these conditions, the earlier they tended to develop POAG.

Both Type 2 diabetes and hypertension are disease that affect blood vessels of both the optic nerve and retina, thus potentially causing changes that predispose patients to POAG, another condition with a vascular root.

Type 2 diabetes could be considered part of a list of factors that can trigger POAG



<https://medicaldialogues.in/ophthalmology/news/early-onset-of-diabetes-hypertension-led-to-risk-of-early-glaucoma-98294>

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Changes in Color Vision

Color vision changes may appear in persons with diabetes and can precede the development of diabetic retinopathy

Acquired color vision changes can occur in both blue-yellow and red-green discrimination

Shown to correlate with the duration of diabetes

The presence of macular edema is also a strong predictor of poor color discrimination

Source: aao.org/DiabetesStandardofCare

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Extended Color Vision Testing

- Approximately 50% of Early Treatment Diabetic Retinopathy Study patients had color vision scores (SQRT-100) worse than 95% of those with normal findings. A tritan-like defect was prominent
- Color vision was assessed in insulin-dependent diabetic patients using the Farnsworth-Munsell 100-Hue Test. All showed color vision impairment
- **Computerized Extended Color vision** testing should show similar results

Source: <http://care.diabetesjournals.org/content/77/4/318.short>

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Digital Extended Color Vision Testing

The image shows a computer workstation with a monitor displaying a software interface for digital extended color vision testing. The interface includes a patient information section, a 'Results' section with a bar chart, and a 'Diagnosis' section with a network diagram. The monitor is a CCT-1 model.

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RETINAL NEURODEGENERATION

Color Vision Assessment

- Dyschromatopsia of diabetes is a chromatic visual disturbance that precedes clinical diabetic retinopathy in up to 42% of patients
- Color vision impairment is related to the duration of the diabetes
- Because both red-green and blue-yellow defects occur in diabetic patients without clinical retinopathy, these sensory abnormalities are likely attributable to a generalized neural-glial retinal dysfunction

The image shows a person sitting at a desk, looking at a computer monitor. The monitor displays a digital color vision testing application. The person is wearing glasses and has their hand near their face, possibly resting their chin on their hand.

Geetha L, Ramani R, Kulothungan V, Pal SS, Ganesan S, Srinivasan S, Sharma T. Color vision abnormalities in type II diabetes. Sankarā Nethralaya Diabetic Retinopathy and Molecular Genetics Study II report no 2. Indian J Ophthalmol. 2017 Oct; 65(10): 989-994.

Guaffieri et al. Early visual changes in diabetic patients with no retinopathy measured by color discrimination and electroretinography. Psychology & Neuroscience, 2013, 6, 2, 227-234. DOI: 10.3922/psns.2013.2.11

86

Accommodative Dysfunction

Accommodative ability may be altered

Sensory Motor Examination

A decrease of accommodation is usually transient and improves with control of glucose levels

Source: aoa.org Diabetes Standard of Care

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Visual Field Changes

- Secondary to preretinal and vitreous hemorrhages
- Secondary to new vessel growth and fibrous proliferation on the retina
- Secondary to neovascular or primary open angle glaucoma
- Secondary to posterior vitreous detachment
- Secondary to papillopathy, ischemic optic neuropathy or peripheral retinal ischemia
- Secondary to panretinal (scatter) laser photocoagulation

Source: aoa.org Diabetes Standard of Care

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Common Ocular Manifestations of those living with diabetes

Diabetic Retinopathy

Early Diabetic Retinopathy Moderate Diabetic Retinopathy Severe Diabetic Retinopathy

The image shows three fundus photographs illustrating the progression of diabetic retinopathy. The first shows a normal fundus with clear vessels. The second shows early changes with microaneurysms and small hemorrhages. The third shows severe changes with extensive hemorrhages, cotton wool spots, and neovascularization.

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Four Stages of Diabetic Retinopathy

TABLE. Diagnosing Diabetic Retinopathy

| DIABETIC RETINOPATHY LEVEL | RETINAL FINDINGS |
|----------------------------|--|
| Mild NPDR | MAs only |
| Moderate NPDR | At least one hemorrhage or MA and/or at least one of the following: <ul style="list-style-type: none"> Retinal hemorrhages Hard exudates Cotton wool spots Venous beading |
| Severe NPDR | Any of the following but no signs of PDR (4-2-1 rule): <ul style="list-style-type: none"> > 20 intraretinal hemorrhages in each of four quadrants Definite venous beading in two or more quadrants Prominent IRMA in one or more quadrants |
| PDR | One of either: <ul style="list-style-type: none"> Neovascularization Vitreous/preretinal hemorrhage |

Abbreviations: IRMA, intraretinal microvascular abnormality; MA, microaneurysm; NPDR, nonproliferative diabetic retinopathy; PDR, proliferative diabetic retinopathy

Source: Modern Optometry June 2019

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Diabetic Retinal Neuropathy

- Diabetic neuropathies are the most prevalent chronic complications of diabetes
- Heterogeneous group of conditions affects different parts of the nervous system and presents with diverse clinical manifestations
- Patients with prediabetes may also develop neuropathies that are similar to diabetic neuropathies
- Due to a lack of treatments that target the underlying nerve damage, prevention is the key component of diabetes care.



Source: Diabetes Care 2017;40:136–154 | DOI: 10.2337/dc16-2042

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Classification for Diabetic Neuropathies

Distal symmetric polyneuropathy (DSPN)

- One of the most studied diabetic neuropathies
- DSPN and autonomic neuropathy are the most common forms encountered in practice
- DSPN is the most common, chronic complication of diabetes
- It predisposes patients to severe functional limitations including unremitting pain and unsteadiness



Source: Diabetes Care 2017;40:136–154 | DOI: 10.2337/dc16-2042

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DIABETIC RETINOPATHY IS A NEUROVASCULAR DISORDER

RETINAL VASCULOPATHY

- Capillary nonperfusion
- Capillary remodeling
- Microaneurysms / IRMAs
- Exudates / cotton wool spots
- Venous beading
- Retinal hemorrhages
- Retinal edema
- Retinal ischemia
- Neovascularization

RETINAL NEURODEGENERATION

- Reduced thickness of the inner retinal layers
- Reduced thickness of the nerve fiber layer
- Loss of ganglion cells
- Loss of photoreceptors



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DIABETIC VASCULOPATHY

The diagnosis of clinical diabetic retinopathy has historically relied on the detection of microvascular lesions using ophthalmoscopy or intravenous fluorescein angiography



Diabetes-induced biochemical alterations result in a breakdown of the blood-retinal barrier and then hypoxia, vascular leakage and neovascularization characterize the vasculopathy

Almost 5% of Americans have sight-threatening retinopathy and macular edema is the most common cause of permanent vision loss

No level of blood glucose is totally protective against diabetic retinopathy



Source: Diabetologia 66, 1614–1621 (2023). <https://doi.org/10.1007/s00125-023-05940-5>

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How Do We Diagnose Diabetic Retinopathy in 2024?

RETINAL NEURODEGENERATION

- Optical coherence tomography
- Threshold visual field examination
 - Frequency doubling technology
 - 10-2 macula test protocol
- Color vision examination
- Electroretinography
- Contrast sensitivity
- Dark adaptometry
- Macular pigment optical density

RETINAL VASCULOPATHY

- Careful dilated fundus examination
 - Peripheral retina
- Optical coherence tomography
 - Spectral-domain
 - Angiography
- Widefield retinal imaging
- Fluorescein angiography
- Multi-spectral imaging



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WHAT IS DIABETIC RETINOPATHY?

Two distinct but inter-related disease processes:

Microvascular disease of the retina that is based on the observation of vascular changes or the presence of abnormal vascular lesions

Retinal neurodegeneration that is characterized by a loss/derangement of neural elements of the retina

- Ganglion cell bodies
- Photoreceptors
- Nerve fiber layer



Jackson GR, Scott IU, Quillen DA, Walter LE, Gardner TW. Inner retinal visual dysfunction is a sensitive marker of non-proliferative diabetic retinopathy. *British Journal of Ophthalmology* 2012;96:699-703.

96

SUBCLINICAL DIABETIC RETINOPATHY

- In diabetes, a structure-function relationship exists between neurodegeneration and vision loss
- In many patients, retinal neurodegeneration leading to vision loss can be detected without visible retinal vasculopathy
- neurodegeneration could be a biomarker for subsequent vascular damage to the retina
- Retinal neurodegeneration could be a sign of more widespread damage to the neural system
 - Peripheral neuropathy
 - Neuro-psychological disturbances

Source: Leckie-Cabel A. Evaluation of Retinal Function and Flicker Light-Induced Retinal Vascular Response in Homozygous Patients with Diabetes without Retinopathy. *Invest Ophthalmol Vis Sci.* 2011;52(26):2827

97

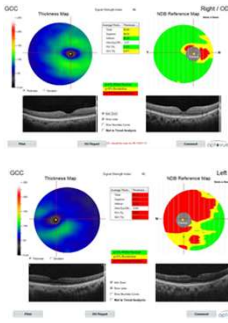
Testing Retinal Neurodegeneration in Diabetes

- OCT is now used to demonstrate thinning of the inner retina including the retinal nerve fiber layer (RNFL), ganglion cell layer (GCL), and more variably the inner plexiform layer (IPL) can be seen in patients
- Functional deficits in contrast sensitivity, perimetry testing, multifocal electroretinogram (mfERG), and dark adaptation have also been described in diabetic patients without DR or with very early DR
- Changes in inner retinal thickness and visual function deficits occur prior to clinical DR in patients with DM

Source: *Curr Diab Rep.* 2011;11(2): 65.

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RETINAL NEURODEGENERATION



Ganglion Cell Analysis

- Clinically significant ganglion cell complex focal loss volume predates observable retinal vasculopathy in 22% of patients with diabetes
- An increase in myopia is accompanied by an increase in ganglion cell complex focal loss volume in patients with diabetes
- Ganglion cell complex focal volume loss is accompanied by an increase in the cup-to-disc ratio in diabetic eyes

Hegazy, Razha H, Zedan, Tamer A, Macky, Soheir M, Esmail, Refinal ganglion cell complex changes using spectral domain optical coherence tomography in diabetic patients without retinopathy. *Int J Ophthalmol* 2017;10(3):427-433. doi:10.18240/ijo.2017.03.16
 Source: www.mdpi.com/journal/ijms, *Int. J. Mol. Sci.* 2013, 14
www.wjngnet.com, May 15, 2010/Volume 1/Issue 2]

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RETINAL NEURODEGENERATION

My Clinical tools for detecting diabetic retinal neurodegeneration

- Multifocal Electroretinography
- Full Field Electroretinography
- Contrast Sensitivity
- Extended Color Vision Testing
- Visual Field Testing / Frequency Doubling
- Dark Adaptometry

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RETINAL NEURODEGENERATION



There are several portable, self-contained, hand-held device that measures visual function using a full-field electroretinogram testing protocol

Electroretinography

- Light-adapted flicker ERG elicits response from cone bipolar cells
- ERG waveform peak time has been shown to be a sensitive measurement in some patients with ischemic diseases such as diabetic retinopathy

Fukuo, M, et al. Screening for diabetic retinopathy using new mydriatic-free, full-field flicker ERG recording device. *Sci. Rep.* 6, 36592. doi:10.1038/srep36592 (2016)

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Full Field(ffERG) or Multifocal Electro Retinography m(ERG)



An objective measure of global retinal function. Several studies have emphasized its utility in managing diabetic retinopathy
 ffERG testing is useful for discerning retinal dysfunction in eyes with diabetic retinopathy, making it a powerful tool for the diagnosis and staging of the disease
 Full-field ERG is complementary to OCT, extended color vision diagnostics and standard threshold visual fields

Wu et al. Portable negative response obtained using a handheld electroretinogram device: determining the optimal measure and repeatability. *Translational Vision Science & Technology*, 2016
 Wilson et al. Portable Negative Response using a Handheld Electroretinogram in Early Diabetic Retinopathy. *Ophthalmology & Visual Science*, 2015
 Wilson et al. Screening for diabetic retinopathy using new mydriatic-free, full-field flicker ERG recording device. *Scientific Reports*, 2016
 Wilson et al. A new method for portable and efficient testing of visual function using a handheld electroretinogram. *Investigative Ophthalmology and Visual Science*, 2016
 Wilson et al. Portable aspects of the electroretinogram in diabetic retinopathy. *Arch Ophthalmol*, 1987;105:650-654
 Wilson et al. Screening for diabetic retinopathy using a handheld electroretinogram device. *Investigative Ophthalmology and Visual Science*, 2015;56:2500-2505
 Wilson et al. A new method for portable and efficient testing of visual function using a handheld electroretinogram. *Investigative Ophthalmology and Visual Science*, 2016;57:1045-1050
 Wilson et al. A new method for portable and efficient testing of visual function using a handheld electroretinogram. *Investigative Ophthalmology and Visual Science*, 2016;57:1045-1050
 Wilson et al. A new method for portable and efficient testing of visual function using a handheld electroretinogram. *Investigative Ophthalmology and Visual Science*, 2016;57:1045-1050

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POTENTIAL DEFICIENCIES IN SENSORY CAPACITY

- Decreased color vision
- Delayed dark adaptation
- Abnormal visual fields
- Abnormal electroretinogram (ERG) →
- Decreased visual acuity
- Decreased contrast sensitivity

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Full Field(ffERG) a New Standard

| Testing method | Incidence rate Yr. 1 | Incidence rate Yr. 2 | Incidence rate Yr. 3 |
|--|----------------------|----------------------|----------------------|
| Structural Testing Alone (VTDR+) | 19% | 31% | 53% |
| Functional Test Alone (RETeval DR Score > 23.4) | 23% | 41% | 65% |
| Functional & Structural: VTDR+ and RETeval DR Score > 23.4 | 34% | 54% | 74% |
| Functional & Structural: VTDR+ and RETeval DR Score ≤ 23.4 | 3% | 4% | 29% |

Progression risk assessment:

- Combining structural and functional information provides better risk assessment results

*VTDR - Vision Threatening Diabetic Retinopathy defined as clinically significant macular edema and ETDRS-DR severity ≥ level 53, severe NPDR or PDR.

Source: <https://www.diagnosysinc.com/multifocal-erg-mferg/>

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Electroretinograms (ERG) are affected by DR

First published in 1987, results replicated in the North & South America, Europe, and Asia
13 publications using RETeval device

Zeng et al. (2019) "Screening for Diabetic Retinopathy in Diabetic Patients with a Mydriasis-Free, Full-Field Flicker Electroretinogram Recording Device". Documenta Ophthalmologica. <https://doi.org/10.1007/s10663-019-09734-2>

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Full Field(ffERG) a New Standard

- The DR Assessment Protocol produces a DR score based on four components:
 - Best eye's 32 Td-s implicit time - longer times increase score
 - Best eye's 16 Td-s amplitude - smaller amplitudes increase score
 - Worst eye's 4 Td-s to 32 Td-s pupillary response - less reactive pupils increase score
 - Age
- Increasing scores indicate increasing disease severity
- Clinically validated in multiple cross-sectional and longitudinal studies for the detection of VTDR and the prediction of DR disease progression
- If the DR Score is greater than 23.4 the patient has an 11 times increased risk of needing an ocular intervention within 3 years!

1. Brigell et al. (2020) Enhancing Risk Assessment in Patients with Diabetic Retinopathy by Combining Measures of Retinal Function and Structure, TVST

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DR Assessment Normal

DR Assessment Abnormal

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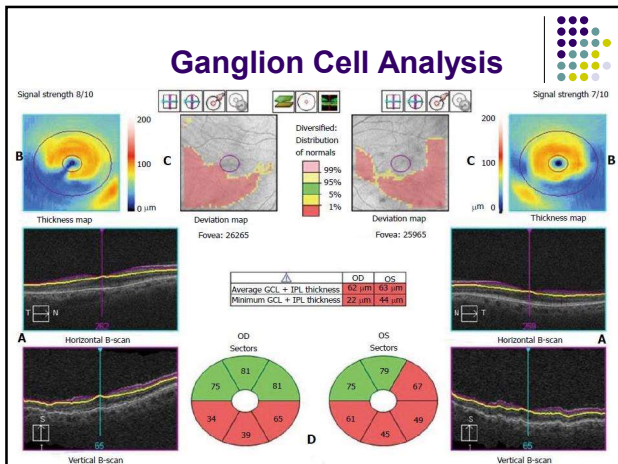
●115

OCT Ganglion Cell Analysis

Reduction of ganglion cell density is association with glaucoma and diabetes
Early detection leads to earlier treatment and strategies before detectable visual field loss

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5892052/>
[https://www.aaojournal.org/article/S0161-6420\(14\)00183-3/abstract](https://www.aaojournal.org/article/S0161-6420(14)00183-3/abstract)
<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4594487/>
 *Kim K, Kim E Yu S. Longitudinal relationship between retinal diabetic neurodegeneration and progression of diabetic retinopathy in patients with type 2 diabetes. Am J Ophthalmol. www.ajo.com/article/S0002-9394(18)30515-4/fulltext. September 26, 2018. Accessed October 1, 2018.

●116



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RETINAL VASCULOPATHY

“Findings Observable upon Dilated Ophthalmoscopy”

- Retinal vascular occlusions
- Separation of the retinal layers
- Microaneurysms
- Cotton wool spots
- Exudates
- Hemorrhages
- Fibrous proliferation

●118

Optical Coherence Tomography

RETINAL VASCULOPATHY

- Clinically significant macular edema may be present without visible vascular lesions and in the presence of 20/20 acuity
- Retinal thickening within 500 microns of the macular center
- Hard exudates within 500 microns of the macular center with adjacent retinal thickening
- One or more disc diameters of retinal thickening, part of which is within one disc diameter of the macular center

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RETINAL VASCULOPATHY

Coherence Tomography

- A noninvasive examination technique that can visualize retinal blood micro-circulation down to the capillary level
- The instrument creates angiograms by assessing the change in OCTA signal caused by flowing red blood cells
- In contrast to fluorescein angiography, OCTA data is three-dimensional and can be visualized in divided tissue slabs

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RETINAL VASCULOPATHY

Retinal Blood Microcirculation Abnormalities in Diabetes

- Remodeling of peri foveal capillaries
- Capillary dropout in the inner retina
- Enlargement of the foveal avascular zone
- Macular telangiectasia
- Microaneurysms
- Other retinal hemorrhages
- Hard exudates
- Neovascularization
- Macular edema

2022

Source: Anand-Apte B, Hollyfield JG. Developmental Anatomy of the Retinal and Choroidal Vasculature. Research Gate. DOI:10.1016/B978-0-12-374203-2.00169-X

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Superficial Capillary Plexus

• OCT angiogram is normal and includes vascular data from the retinal nerve fiber layer and ganglion cells

Deep Capillary Plexus

• Normal OCT angiogram appears as a uniform organization of mini vortices

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Full Field(ffERG) or Multifocal Electro Retinography m(ERG)

An objective measure of global retinal function. Several studies have emphasized its utility in managing diabetic retinopathy

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Full-field ERG is complementary to OCT, extended color vision diagnostics and standard threshold visual fields

Wu et al. Photopic negative response obtained using a handheld electroretinogram device: determining the optimal measure and repeatability. Translational Vision Science & Technology. 2016.

Preiser et al. Photopic Negative Response versus Pattern Electroretinogram in Early Glaucoma. Investigative Ophthalmology & Visual Science. 2013.

Mao et al. A novel device for accurate and efficient testing for vision-threatening diabetic retinopathy. Journal of Diabetes and its Complications. 2015.

Fukuo et al. Screening for diabetic retinopathy using new mydriasis-free, full-field flicker ERG recording device. Scientific Reports. 2016.

Doc Ophthalmol. 2011 December ; 125(3): 187-192. doi:10.1007/s10633-011-9297-7. Christine L. Talamini, Ali S. Raza, Elizabeth A. Dale, Vivienne C. Greenstein, Jeffrey G. Odel, and Donald C. Hood.

Brennan GH, Patel M. Temporal aspects of the electroretinogram in diabetic retinopathy. Arch Ophthalmol. 1987; 105:660-664.

Hologgiari K, Greenstein VC, Seiple W, Hood DC, Carr RE. Evidence for photoreceptor changes in patients with diabetic retinopathy. Invest Ophthalmol Vis Sci. 1997; 38:2385-2395.

Kim SH, Lee SH, Bae JY, Cho JH, Kang YS. Electroretinographic evaluation in adult diabetics. Doc Ophthalmol. 1997; 1998:94-201-213.

Pescosolido N, Barbato A, Stefanucci A, Buomprisco G. Role of electrophysiology in the early diagnosis and follow-up of diabetic retinopathy. J Diabetes Res. 2015;319992.

Tzakov R, Arden GB. The electroretinogram in diabetic retinopathy. Surv Ophthalmol. 1999;44:53-60.

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DIGITAL RETINAL PHOTOS

- Attenuated vasculature
- Mild tortuosity
- No visible retinal hemorrhages
- No subclinical diabetic retinopathy

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DIGITAL RETINAL PHOTOS

- Attenuated vasculature
- Mild tortuosity
- No visible retinal hemorrhages
- No subclinical diabetic retinopathy

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CCT-HO

OCTA RETINAL IMAGING

- Normal retinal blood microcirculation
- Normal structural examination of the macula
- No subclinical diabetic retinopathy

| DATA | Cone | Psi | | Trials | Ave Time | Score | Category* |
|------|---------|-----------|-------|--------|----------|--------------------------|--------------------------|
| | | Threshold | Score | | | | |
| OD | Red L | 1.4% | 30 | 1.7 | 95 | Normal | Normal |
| | Green M | 1.1% | 30 | 2.0 | 107 | Normal | Normal |
| | Blue S | 43.4% | 30 | 1.6 | 56 | Color Deficient (Tritan) | Color Deficient (Tritan) |
| OS | Red L | 1.0% | 30 | 1.7 | 106 | Normal | Normal |
| | Green M | 1.8% | 30 | 1.9 | 86 | Possible (Deutan) | Possible (Deutan) |
| | Blue S | 45.4% | 30 | 1.8 | 54 | Color Deficient (Tritan) | Color Deficient (Tritan) |

*Cutoff criteria are physician selected from custom, or user input score method ranges and corresponding assigned categories.

RESULTS

Notes

Learned, developed, and validated under FDA's by Konan Medical USA in collaboration with the United States Air Force School of Aerospace Medicine (USAFSAM) at Brooks AFB, Texas (Contract # FA9550-02-1-0001). Copyright ©2017. All rights reserved. Vision Assessment Laboratory.

KONAN MEDICAL
HUMAN REFERENCE CENTER

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

128

OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

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73 year old Black Man

Case Report

Medical Hx:

- Type 2 diabetes
- Episode of hypoglycemia August 2021
- Hypertension
- Hypercholesterolemia
- Ocular Hx
- Primary open angle glaucoma
- Dry Eye
- Early NS cataracts

Medications:

- Advair Diskus 100-50 mcg/dose Inhalation
- Adult Low Dose Aspirin 81 mg
- amlodipine 10 mg
- atorvastatin 80 mg
- fraxiparin 5 mg
- lisinatin-hydrochlorothiazide 25 mg
- metformin 500 mg
- Fish oil
- stool softener
- Potassium Chloride
- MacuHealth
- Oasis Tears

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DIGITAL EXTENDED COLORVISION TESTING

- Attenuated vasculature
- Mild tortuosity
- No visible retinal hemorrhages
- No subclinical diabetic retinopathy

CCT-HD

| | Color | Psi | Threshold | Trials | Ave Time | Score | Category |
|----|-----------|-------|-----------|--------|----------|-------------------------|----------|
| OD | Red - S | 1.4% | 12 | 2.2 | 97 | Normal | |
| | Green - M | 0.9% | 18 | 2.8 | 112 | Normal | |
| | Blue - S | 30.8% | 30 | 1.8 | 88 | Color Deficient (H/Pan) | |
| OS | Red - L | 1.8% | 30 | 2.6 | 88 | Positive | |
| | Green - M | 2.3% | 30 | 3.1 | 75 | Color Deficient (H/Pan) | |
| | Blue - S | 54.4% | 30 | 2.2 | 86 | Color Deficient (H/Pan) | |

RESULTS

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FULL FIELD ERG

- Signal Strength
- Signal Speed
- Pupil diameter
- Pupil movement

Device and Test Information

RET-100™
 Serial Number: 8002345
 Firmware version: 2.11.2 (Reference date: 2020-01-16)
 Test protocol: 08 Assessment
 Electrodes: Sensor Strips

Right Eye

Left Eye

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DIGITAL RETINAL PHOTOS

- Vessel attenuation
- Mild tortuosity and crossing changes
- Primary open angle glaucoma

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

134

OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

135

OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

January 2019

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

January 2019

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RETINAL SPECIALIST REPORT

VA OD: Dcc20/20. PHNT. **OS:** Dcc20/40+1. PH20/30+2. **IOP:** TP **OD:** 14 **OS:** 20 8:23 AM

Imp / Plan:

1. Resolved Stage 2 Macular Hole OS (4/5 03/28/19). Is os junction improving slowly, extend vitus.
2. Nuclear Sclerosis OS. Reviewed expected progression of cataract following Vitrectomy. Reviewed need for quiescence for at least 6 months before consider CE.
3. PCMO, Mild OU. Follow-up with general ophthalmologist / glaucoma specialist as scheduled.
4. Diabetes, Type II, No Ocular Complications. Not Insulin Dependent. No active Diabetic Retinopathy is present on examination. Control blood glucose, blood pressure, cholesterol; follow-up with primary care physician and/or endocrinologist. Reviewed importance of regular dilated eye exams to minimize risk of vision loss.
5. Low Myopia OU.

January 2019

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LABS

| Component | Latest Ref Range & Units | 12/20/2021 12:03 AM | 12/20/2021 7:02 AM | 12/20/2021 7:03 AM | 12/20/2021 7:31 AM | 12/20/2021 7:31 AM |
|-------------------------------|----------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| Cholesterol, Total | 0.0 - 5.0 ratio | | | 4 | | 4 |
| VLDL Cholesterol Cal | <= 30 mg/dL | | | 17 | | 18 |
| WBC | 5 - 9 /mm ³ | None seen | | | | |
| RBC | 5 - 9 /mm ³ | None seen | | | | |
| Erythrocyte Cells (non renal) | 0 - 12 /mm ³ | None seen | | | | |
| CAIT Urine | None seen /mm ³ | None seen | | | | |
| Bacteria Urine | None seen /mm ³ | None seen | | | | |
| MAA B URINE | 0.0 - 17.0 mg/dL | | | | | |
| CREATININE UR RANDOM | 15.00 - 27.00 mg/dL | 138.81 | | | | |
| MAA URINE CALC | 0.0 - 29.0 mg/dL | 17.6 | | | | |
| HEMOGLOBIN A1C | 4.0 - 5.6 % | | | 7.4 (H) | | 8.1 (H) |
| ESTIMATED AVERAGE GLUCOSE | mg/dL | | | 192 | | 203 |

January 2019

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HEALTH ACTION PLAN

Personal Health Action Plan Date: 7/5/21

I agree to a health action plan for living good vision being with:

borderline for diabetes living with diabetes living with hypertension

I want to make healthy vision a health priority. I pledge to do the following to be healthier and maintain good eye health:

Return yearly or as my doctor directed to Vision Station for a dilated eye, digital eye imaging, and an other diagnostic diabetic eye evaluation and testing.

Maintain my glucose levels under control and follow a daily average of self-check blood sugar _____ times per _____ days. _____ weeks.

Average daily blood sugar _____ of _____ All goal _____ 6.50

Maintain my blood pressure at 130/90 mmHg or _____

Maintain my cholesterol levels within a healthy range. Total Cholesterol goal _____ HDL (good cholesterol) goal _____ LDL (bad cholesterol) goal _____

Walk or other physical activity at least _____ minutes a day _____ times a week.

Eat a daily food log _____ days a week.

Eat adequate fruits _____ servings /day _____ days/week. Consume adequate vegetables _____ servings/day _____ days/week and reduce carbohydrates.

If my weight loss is desired, my weight goal in 3 months is _____ lbs and in 6 months is _____ lbs. My 6 week weight goal is _____ lbs.

My weekly weight loss goal is _____ lbs. My monthly weight loss goal is _____ lbs.

Take all medication(s) as prescribed by my doctor.

Take or consider supplements as prescribed or recommended by my doctor. (Self-refer or email in _____ Diabetes Prevention Program Session(s) _____ Diabetes Self-management Session(s) _____ Medical Nutrition Therapy Session(s) within _____ weeks)

I want to make healthy lifestyle choices; my family name and control to the above plan.

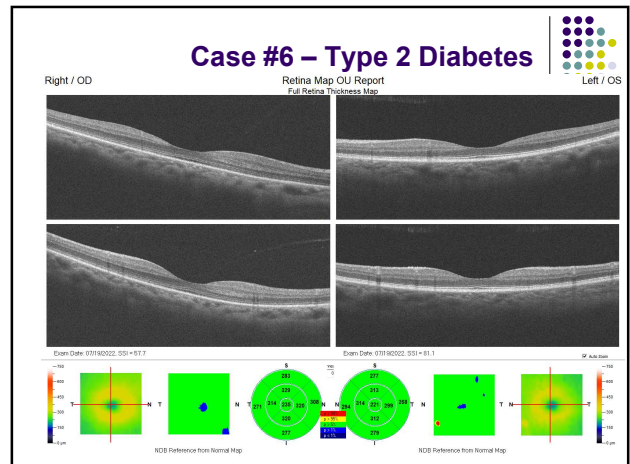
[Signature] Date: 7/5/21

140

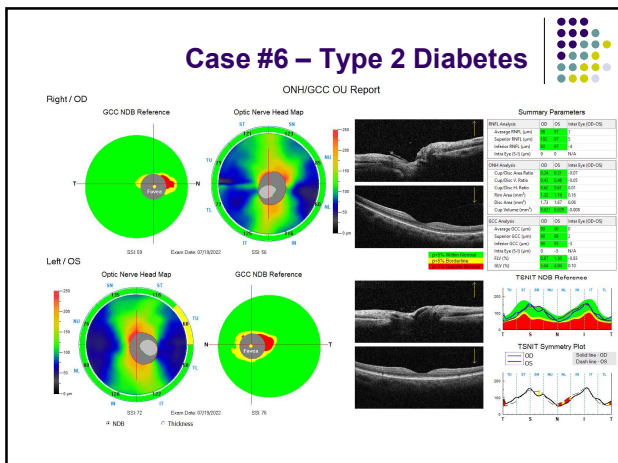
Case #6 – Type 2 Diabetes

- 61 year old African American Woman
- Type 2 diabetes
- Osteo Arthritis
- Hypercholesterolemia
- Migraines HA's
- Diabetes with peripheral neuropathy
- Combined Cataracts
- Background diabetic retinopathy
- Subclinical diabetic vasculopathy
- Irregular afoveal zone on OCT A
- Meds:
 - Metformin, omeprazole, pravastatin, sertraline, tizanidine
- Height 5' 4"
- Weight 176 lbs
- BMI 30.2

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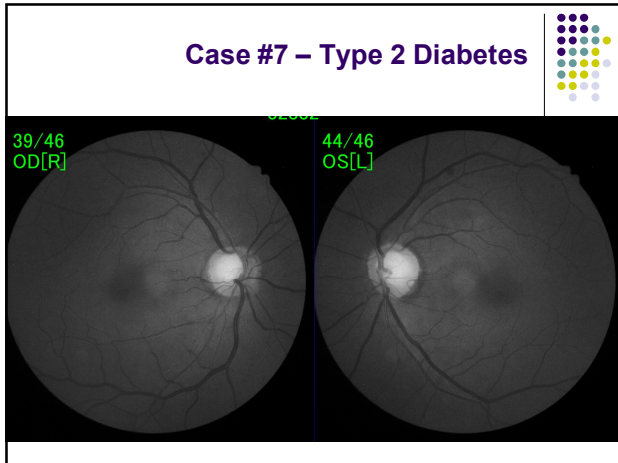


143

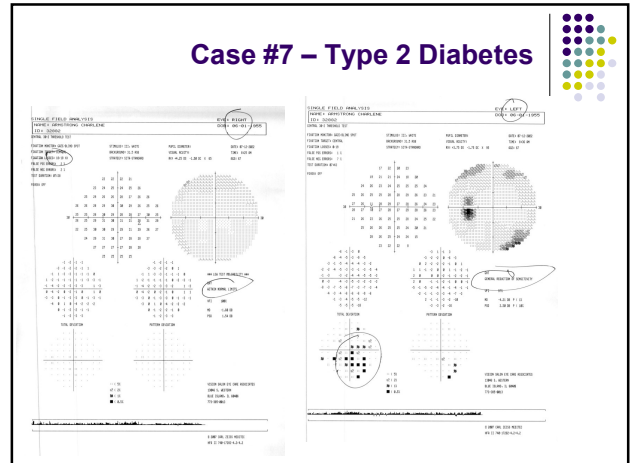
Case #7 – Type 2 Diabetes

- 67 year old African American Woman
- Type 2 diabetes since 2000
- Last A1c 10.0 2022 morning blood glucose 143
- Asthma
- Primary open angle glaucoma
- Meds:
 - Travoprost, B Complex Vitamin B12, Vitamin D3, aspirin 81 mg tablets, atorvastatin, celecoxib, pantoprazole, ramipril, triamterene, Bydureon Bcise auto-injector, Lantus 100 unit insulin, Symbicort, Humalog insulin, Women's multivitamin. Taken of Metformin and now taking unknown diabetes medication.
 - Budesonide-formoterol, Bydureon BCISE, Rybelsus 7mg, triamterene
- Height 5' 4"
- Weight 190 lbs
- BMI 32.6

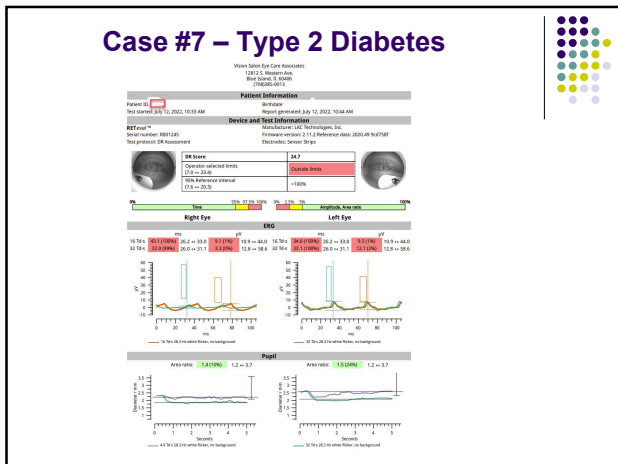
144



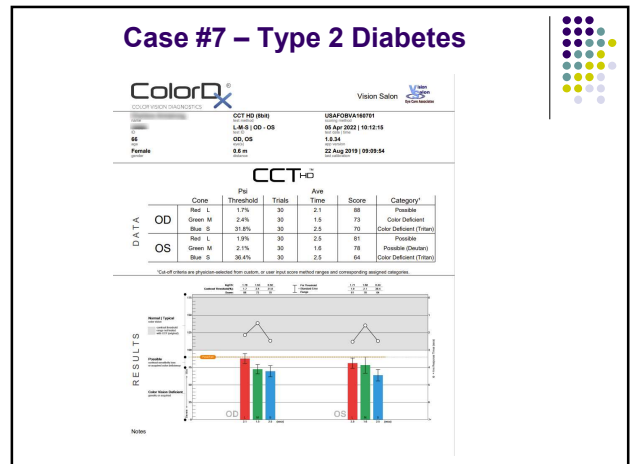
151



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Case #3 – Diabetes Vasculopathy

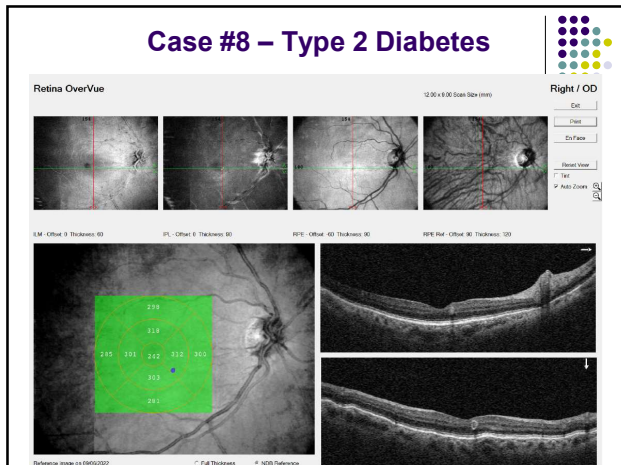
- 19-Year-old African American Man
- College student
- Type 2 Diabetes Dx'd in 2018
- Hypercholesterolemia
- Meds:
 - Novolog Flexpen U-100
- In office Blood pressure 121/91
- Height 5'11"
- Weight 270
- BMI 38.2

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Case #3 – Diabetes Vasculopathy

- BVA
- OD 20/30- OS 20/30-2 OU 20/25-
- Rx
 - +0.75 -3.75 X 170
 - -0.50 -5.50 X 180
- IOP OD 22 OS 21 C:D OD .30 OS .30

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73 year old Black Man

Case Report

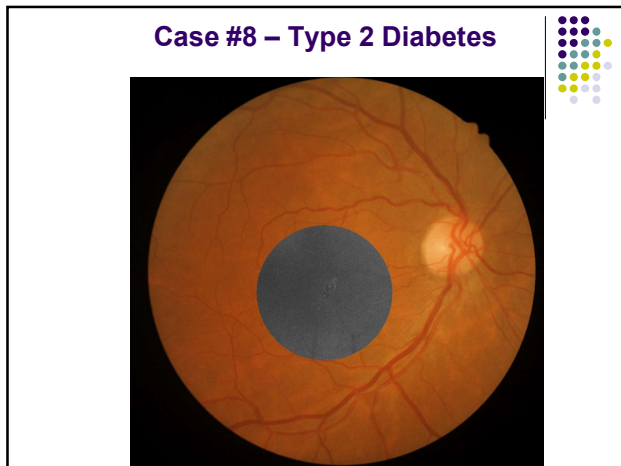
Medical Hx

- Type 2 diabetes
- Episode of hypoglycemia August 2021
- Hypertension
- Hypercholesterolemia
- Ocular Hx
 - Primary open angle glaucoma
 - Dry Eye
 - Early NS cataracts

Medications

- Advair Diskus 100-50 mcg/dose Inhalator
- Adult Low Dose Aspirin 81 mg
- amlodipine 10 mg
- atorvastatin 80 mg
- frutasteride 5 mg
- Isartan-Hydrochlorothiazide 25 mg
- medrosteron 500 mg
- Fish oil
- stool softener
- Potassium Chloride
- MacuHealth
- Oasis tears.

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CCT-H₀

DIGITAL EXTENDED COLORVISION TESTING

- Attenuated vasculature
- Mild tortuosity
- No visible retinal hemorrhages
- No subclinical diabetic retinopathy

| | Cone | Psi | Trials | Ave | Score | Category* |
|----|---------|-------|--------|-----|-------|---------------------------|
| OD | Red L | 1.4% | 12 | 2.2 | 97 | Normal |
| | Green M | 5.9% | 18 | 2.8 | 112 | Normal |
| | Blue S | 26.6% | 30 | 1.8 | 85 | Color Deficient (Fifteen) |
| OS | Red L | 1.8% | 30 | 2.6 | 86 | Positive |
| | Green M | 2.3% | 30 | 3.1 | 75 | Color Deficient |
| | Blue S | 54.4% | 30 | 2.2 | 48 | Color Deficient (Fifteen) |

*Cut-off criteria are physician-selected from custom, or user input score method targets and corresponding assigned categories.

RESULTS

Notes: Low-pass, down-sampled, and processed under CIECAM02 by Konan Medical USA in collaboration with the Konan Group, Inc. Color Deficient categories: Deuteranope (D), Protanope (P), Tritanope (T), Tritanomaly (TA), Deuteranomaly (DA), Protanomaly (PA), Tritanomaly (TA).

KONAN MEDICAL
KonanMedical.com/ColorVis

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FULL FIELD ERG

- Signal Strength
- Signal Speed
- Pupil diameter
- Pupil movement

Device and Test Information

Model: 8001245
Serial number: 8001245
Manufacturer: Konan Medical, Inc.
Firmware version: 1.11.2 Reference Data: 2020-01-04/2021-01-04
Electrode: Standard Single

ERG

Right Eye: 10 Hz: 183 (100%), 26.5 ± 10.3 (12.0PN), 10.3 mV @ 60 Hz, 10 Hz: 183 (100%), 26.5 ± 10.3 (12.0PN), 10.3 mV @ 60 Hz, 30 Hz: 208 (100%), 30.3 ± 11.4 (13.0PN), 12.2 mV @ 60 Hz, 30 Hz: 208 (100%), 30.3 ± 11.4 (13.0PN), 12.2 mV @ 60 Hz

Left Eye: 10 Hz: 183 (100%), 26.5 ± 10.3 (12.0PN), 10.3 mV @ 60 Hz, 10 Hz: 183 (100%), 26.5 ± 10.3 (12.0PN), 10.3 mV @ 60 Hz, 30 Hz: 208 (100%), 30.3 ± 11.4 (13.0PN), 12.2 mV @ 60 Hz, 30 Hz: 208 (100%), 30.3 ± 11.4 (13.0PN), 12.2 mV @ 60 Hz

Pupil

Average: 1.9 (100%), 1.2 ± 0.3
Area ratio: 1.5 (100%), 1.2 ± 0.3

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DIGITAL RETINAL PHOTOS

- Vessel attenuation
- Mild tortuosity and crossing changes
- Primary open angle glaucoma

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

January 2019

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OCTA RETINAL IMAGING

- Note capillary vessel dropout
- Note macula avascular zone
- No subclinical diabetic retinopathy

January 2019

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RETINAL SPECIALIST REPORT

VA OD: Dec20/20. PHNT. OS: Dec20/40+1. PH20/30+2. IOP: TP OD: 14 OS: 20 8:23 AM

Imp / Plan:

- Resolved Stage 2 Macular Hole OS (x/p 02/28/19). In os junction improving slowly, extend vitas.
- Nuclear Sclerosis OS. Reviewed expected progression of cataract following vitrectomy. Reviewed need for quiescence for at least 6 months before consider CE.
- POAG, Mild OU. Follow-up with general ophthalmologist / glaucoma specialist as scheduled.
- Diabetes, Type II. No Ocular Complications. Not Insulin Dependent. No active Diabetic Retinopathy is present on examination. Control blood glucose, blood pressure, cholesterol; follow-up with primary care physician and/or endocrinologist. Reviewed importance of regular dilated eye exams to minimize risk of vision loss.
- Low Myopia OU.

January 2019

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LABS

| Component | Latest Ref Req & Units | 12/20/201 | W/ 1/12/2021 | 1/27/2021 | W/ 5/11/2021 | 6/11/2021 | W/ |
|-------------------------------|------------------------|-----------|--------------|-----------|--------------|-----------|----|
| CHOLEsterol Ratio | 0.0 - 5.0 ratio | 2:13 AM | 7:02 AM | 7:03 AM | 7:31 AM | 7:31 AM | |
| WLD Cholsterol Cal | <=50 mg/dL | | | 4 | 17 | 18 | |
| WBC | 0 - 5 /ufl | | | None seen | | | |
| RBC | 0 - 2 /ufl | | | None seen | | | |
| Epithelial Cells (seen smear) | 0 - 10 /ufl | | | None seen | | | |
| CAST URINE | None seen /ufl | | | None seen | | | |
| Bacteria Urine | None seen /ufl | | | None seen | | | |
| MALE URINE | 0.0 - 17.0 mg/dL | | | 2.3 | | | |
| CREATININE UR RANDOM | 0.50 - 2.00 mg/dL | 130.81 | | | | | |
| SERUM CALCI | 8.0 - 10.0 mg/dL | 17.8 | | | | | |
| HEMOGLOBIN A1C | 4.0 - 5.6 % | | | 7.4 (H) | | 8.7 (H) | |
| ESTIMATED AVERAGE GLUCOSE | mg/dL | | | 166 | | 203 | |

January 2019

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HEALTH ACTION PLAN

Personal Health Action Plan Date: 7/5/21

I agree to a health action plan for keeping good vision being with:

borderline for diabetes living with diabetes living with hypertension

I want to make healthy vision a health priority - I pledge to do the following to be healthier and maintain good eye health:

- Return yearly or as my doctor directed to Vision Station for a dilated eye, digital eye imaging, and/or other diagnostic diabetic eye evaluation and testing.
- Maintain my glucose levels under control goal within a daily average of _____
- Self-check blood sugar _____ times per _____ days/weeks
- Average daily blood sugar _____ or less goal: 6.50
- Maintain my blood pressure at 130/80 mmHg or _____
- Maintain my cholesterol levels within a healthy range. Total Cholesterol goal: _____ HDL good cholesterol goal: _____ LDL bad cholesterol goal: _____
- Walk or other physical activity at least _____ minutes a day _____ time(s) a week.
- Sleep a daily total of _____ day(s) a week.
- Eat adequate fruits _____ serving(s) per _____ day/week. Consume adequate vegetables _____ serving(s) per _____ day/week and reduce carbohydrates.
- If weight loss is desired, my weight goal in 3 months is _____ lbs and in 6 months is _____ lbs. My 9-month weight goal is _____ lbs.
- My weekly weight loss goal is _____ lbs. My monthly weight loss goal is _____ lbs.
- Take all medication(s) as prescribed by my doctor.
- Use all exercise/exercises as prescribed or recommended by my doctor. Enroll me in email _____ Diabetes Prevention Program lesson(s) _____ diabetes self-management lesson(s) _____ Medical Nutrition Therapy lesson(s) within _____ weeks

I want to make healthy lifestyle choices for my vision and commit to the above plan.

Patient

Doctor / NP

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SUBCLINICAL RETINOPATHY

- A problem in which symptoms are mild or inapparent, and may not be diagnosed other than by more advanced testing measures
- Subclinical does not mean that the problem is insignificant or that there is no change in physiologic function, but instead it reflects that conventional measures that have been used to evaluate a patient for the presence of disease may not detect changes early in the natural history of the condition
- The presence of subclinical disease is a strong risk factor for disease progression compared to no detectable subclinical disease
- Measurement of subclinical eye disease requires "non-traditional" thinking and modern technology

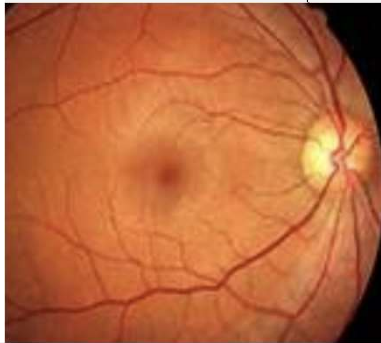
Physical Examination = Physical Diagnosis

A physical diagnosis is a determination supported by various diagnostic tests and procedures (i.e., OCT retinal imaging, threshold visual field exam, etc)

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CONCLUSION

- Is it simply a dilated fundus examination a la 1989 guidelines...
- Is it a super eye exam with wide-field imaging...
- In 2022, a diabetic eye examination should be whatever combination of examinations and diagnostic tests that is medically-necessary to diagnose and treat the ocular complications of diabetes!



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Diabetes and Cataracts

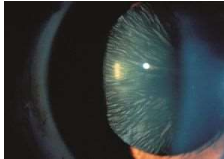
Free radical nitric oxide (NO•) is elevated in the lens and aqueous humor of diabetic patients. Can cause an increase in peroxynitrite formation, which contributes to cell damage due to oxidizing properties

Diabetic lenses have increased susceptibility to oxidative stress due to their impaired antioxidant capacity

8.3% of patients suffering from type 1 diabetes and 24.9% of those with type 2 diabetes had a 10-year cumulative incidence of cataract surgery.

The duration and complexity of cataract surgery are the main risk factors for progression of retinopathy; therefore it is important to reduce the time and complexity of the surgery

Poor visual acuity following cataract extraction is still common in patients with DM. PCO, postoperative cystoid macular edema (CME), DME, and worsening of the DR are the main complications seen in diabetic patients



Source: <https://www.cdc.gov/nchs/products/index.htm>

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DIABETES AND GLAUCOMA

Researchers found that the age of Type 2 diabetes and/or hypertension diagnosis was significantly linked with the onset of POAG.

The earlier patients presented with either or both of these conditions, the earlier they tended to develop POAG.

Both Type 2 diabetes and hypertension are disease that affect blood vessels of both the optic nerve and retina, thus potentially causing changes that predispose patients to POAG, another condition with a vascular root.

Type 2 diabetes could be considered part of a list of factors that can trigger POAG



<https://medicaldialogues.in/ophthalmology/news/early-onset-of-diabetes-hypertension-tied-to-risk-of-early-glaucoma-98294>

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Changes in Color Vision

Color vision changes may appear in persons with diabetes and can precede the development of diabetic retinopathy

Acquired color vision changes can occur in both blue-yellow and red-green discrimination

Shown to correlate with the duration of diabetes

The presence of macular edema is also a strong predictor of poor color discrimination

Source: [aoa.org Diabetes Standard of Care](https://www.aoa.org/DiabetesStandardofCare)

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Extended Color Vision Testing

- Approximately 50% of Early Treatment Diabetic Retinopathy Study patients had color vision scores(SQRT-100) worse than 95% of those with normal findings. A tritan-like defect was prominent
- Color vision was assessed in insulin-dependent diabetic patients using the Farnsworth-Munsell 100-Hue Test. All showed color vision impairment
- **Computerized Extended Color vision** testing should show similar results

•Source: <http://care.diabetesjournals.org/content/17/4/318.short>

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Digital Extended Color Vision Testing



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RETINAL NEURODEGENERATION

Color Vision Assessment

- **Dyschromatopsia of diabetes is a chromatic visual disturbance that precedes clinical diabetic retinopathy in up to 42% of patients**
- **Color vision impairment is related to the duration of the diabetes**
- **Because both red-green and blue-yellow defects occur in diabetic patents without clinical retinopathy, these sensory abnormalities are likely attributable to a generalized neural-glia retinal dysfunction**



Ghella L, Ramani R, Kulothungan V, Pal SS, Ganesan S, Srinivasan S, Sharma T. Color vision abnormalities in type II diabetes: Sankara Neurology Diabetic Retinopathy and Molecular Genetics Study II report no 2. Indian J Ophthalmol. 2017 Oct; 65(10): 989-994.

Guadagni et al. Early visual changes in diabetic patients with no retinopathy measured by color discrimination and electroretinography. Psychology & Neuroscience. 2013; 4, 2: 227-234. DOI: 10.3922/psns.2013.2.11

•Source: [aao.org Diabetes Standard of Care](http://aao.org/DiabetesStandardofCare)

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Accommodative Dysfunction

Accommodative ability may be altered

Sensory Motor Examination

A decrease of accommodation is usually transient and improves with control of glucose levels

•Source: [aao.org Diabetes Standard of Care](http://aao.org/DiabetesStandardofCare)

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Visual Field Changes

- Secondary to preretinal and vitreous hemorrhages
- Secondary to new vessel growth and fibrous proliferation on the retina
- Secondary to neovascular or primary open angle glaucoma
- Secondary to posterior vitreous detachment
- Secondary to papillopathy, ischemic optic neuropathy or peripheral retinal ischemia
- Secondary to panretinal (scatter) laser photocoagulation

•Source: [aao.org Diabetes Standard of Care](http://aao.org/DiabetesStandardofCare)

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American Academy of Ophthalmology Preferred Practice Patterns

Early Detection of Diabetic Retinopathy

- Diabetic Retinopathy may be asymptomatic for years
- **Screening with new technologies is essential**
- When visual complications occur, treatment preserves visual function and is believed to yield a substantial cost savings

•Source: [aao.org Diabetes Standard of Care](http://aao.org/DiabetesStandardofCare)

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Common Ocular Manifestations of those living with diabetes


Dry Eye



Source: <https://www.health.com/eye-health/dry-eye-information>

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DIABETIC VASCULOPATHY




The diagnosis of clinical diabetic retinopathy has historically relied on the detection of microvascular lesions using ophthalmoscopy or intravenous fluorescein angiography

Diabetes-induced biochemical alterations result in a breakdown of the blood-retinal barrier and then hypoxia, vascular leakage and neovascularization characterize the vasculopathy


Almost 5% of Americans have sight-threatening retinopathy and macular edema is the most common cause of permanent vision loss

No level of blood glucose is totally protective against diabetic retinopathy



Source: *Diabetologia* 66, 1614–1621 (2023). <https://doi.org/10.1007/s00125-023-05940-5>

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Hypertension

Hypertensive retinopathy:

- Caused by systemic hypertension
- Causes damage to retinal vasculature

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Hypertension

Hypertensive retinopathy: identifying ocular signs
A four-grade system is used to identify and rate severity

- Grade 1: Mild narrowing of retinal arteries
- Grade 2: More pronounced narrowing and possible arteriovenous crossing changes
- Grade 3: Retinal hemorrhages, exudates and cotton-wood spots
- Grade 4: Severe retinal damage which can include optic disc swelling (papilledema).

Source: <https://ada.com/conditions/hypertensive-retinopathy/>

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Hypertension

Classes and most common Hypertensive Medications

- Beta Blockers: Atenolol, Metoprolol, Propranolol
- Calcium Channel Blockers: Amlodipine, Diltiazem, Verapamil
- Diuretics: Hydrochlorothiazide, Furosemide, Spironolactone
- ACE Inhibitors: Lisinopril, Enalapril, Ramipril
- Angiotensin II Receptor Blockers (ARBs): Losartan, Valsartan, Irbesartan

Source: <https://www.uptodate.com/contents/ocular-effects-of-hypertension>

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Hypertension

Ocular Side Effects of Hypertensive Medications

- Beta Blockers: dry eyes, blurred vision, rare noted is visual hallucinations
- Calcium Channel Blockers: Visual disturbances, blurred vision, and conjunctival hyperemia
- Diuretics: Dry eyes, more rarely visual disturbances
- ACE Inhibitors: Visual disturbances and rarely conjunctivitis
- Angiotensin II Receptor Blockers (ARBs): Visual disturbances and rarely conjunctivitis

Source: <https://www.uptodate.com/contents/ocular-effects-of-hypertension>
<https://eyesoneycare.com/resources/ocular-side-effects-common-medications-cheat-sheet/>

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Hypertension

Other Ocular Side Effects of Hypertension

- **Choroidopathy:** damage to the choroid, pale spots on the choroid (Elschnig spots), Serous retinal detachment
- **Optic Neuropathy:** Optic Disc Pallor, Vision Loss

Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>

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Asthma

Asthma Defined

- Asthma is a chronic (long-term) condition that affects the airways in the lungs.
 - Symptoms of asthma include coughing, wheezing, shortness of breath, and chest tightness
 - Asthma is diagnosed through a combination of medical history, physical examination, and lung function tests. These tests may include spirometry, peak flow measurement, and allergy testing

Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>
 Source: <https://www.mayoclinic.org/diseases-conditions/asthma/diagnosis-treatment/drc-20369660>
<https://www.mayoclinic.org/diseases-conditions/asthma/in-depth/asthma/art-20045198>

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Asthma Treatments

- **Combination inhalers:** These often contain a corticosteroid and a long-acting beta-agonist (LABA). Common side effects include headache and throat infection.
- **Oral corticosteroids:** These have a higher risk of side effects compared to inhaled corticosteroids, including weight gain, insomnia, headaches, and easy bruising of the skin.
- **General corticosteroids:** These can cause swelling in the back of the eye or retina and potentially lead to cataracts.

Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>
 Source: <https://www.mayoclinic.org/diseases-conditions/asthma/diagnosis-treatment/drc-20369660>
<https://www.mayoclinic.org/diseases-conditions/asthma/in-depth/asthma/art-20045198>

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Asthma Treatments

- **Combination inhalers:**
 - Cataracts, delayed wound healing, and increased infection risk
- **Oral corticosteroids:**
 - Steroid-induced glaucoma, cataracts, and increased infection risk
- **General corticosteroids:**
 - Cataracts (PSC), central serous chorioretinopathy, steroid-induced glaucoma

Source: <https://morancore.utah.edu/basic-ophthalmology-review/ocular-side-effects-of-corticosteroids/>
<https://www.healthline.com/health/steroids-and-vision>

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Asthma

- **Ocular Conditions:** Steroid-induced cataracts, glaucoma
- **Latest Technology:** OCT, Visual Field Testing, Pachymetry
- **Evaluation Techniques:** Regular IOP checks, OCT for optic nerve head evaluation, and visual field analysis

Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>

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Asthma

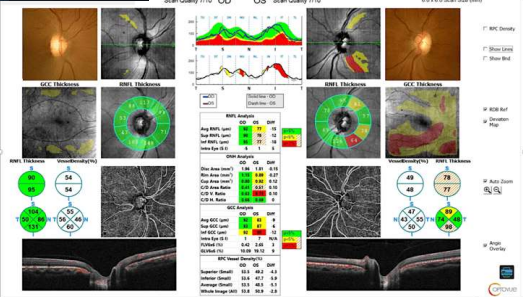



Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>
<https://blog.visionix.com/clinical-studies/solix-glaucoma-protocol>

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Asthma


Pulse oximetry is commonly used to assess oxygen levels in patients with asthma. It is particularly useful during acute asthma attacks

Photo source: <https://www.kelsey-seybold.com/your-health-resources/blog/clearing-the-air-about-asthma>
<https://blog.visionix.com/clinical-studies/sofix-glaucoma-protocol>

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Asthma




Normal Ranges

Pulse: 60 to 100 beats per minute
 Blood Oxygen Levels (SpO2)

- Between 95% and 100%
- Used for oxygen level assessment in acute asthma attacks
- Used to detect hypoxemia early in COVID-19
- Can assess oxygen levels in Chronic Obstructive Pulmonary Disease (COPD)


Source: <https://www.health.com/blood-oxygen-level-8425396>,
<https://www.health.com/blood-oxygen-level-8425396>

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Autoimmune Diseases (e.g., Rheumatoid Arthritis, Lupus)

- Ocular involvement in autoimmune diseases
- Treatment protocols and interprofessional care



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Autoimmune Diseases

- Rheumatoid Arthritis (RA)
- Systemic Lupus Erythematosus (SLE)
- Sjogren's Syndrome
- Multiple Sclerosis (MS)
- Graves' Disease (Thyroid Eye Disease)





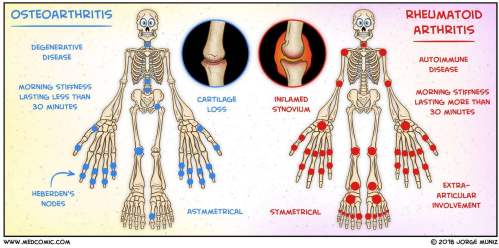
Photo Source: <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>
<https://www.maxhealthcare.in/blogs/what-is-autoimmune-disease>

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Autoimmune Diseases

Rheumatoid Arthritis (RA) vs Osteoarthritis



Source: <https://medicomic.com>

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Autoimmune Diseases

Rheumatoid Arthritis (RA)

- Ocular Side Effects
 - Keratoconjunctivitis sicca (dry eye)
 - Scleritis
 - Episcleritis
 - Uveitis
 - Peripheral ulcerative keratitis




Photo Source: <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>
<https://www.maxhealthcare.in/blogs/what-is-autoimmune-disease>, Am Fam Physician. 2002;66(6):991-998

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Autoimmune Diseases

Rheumatoid Arthritis (RA)

Anterior Segment Photography






Photo Source: <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>
<https://www.maxhealthcare.in/blogs/what-is-autoimmune-disease>, Am Fam Physician. 2002;66(6):991-998

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Autoimmune Diseases

Systemic Lupus Erythematosus (SLE)

- Ocular Side Effects
 - Keratoconjunctivitis sicca (dry eye)
 - Retinal vasculitis
 - Optic neuritis
 - Scleritis
 - Episcleritis



Source: <https://www.aafp.org/pubs/afp/issues/2002/0915/p991.html>

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Autoimmune Diseases

Systemic Lupus Erythematosus (SLE)

- Testing
 - Baseline Examination at diagnosis
 - Special testing with dilated exam with fundus photography and OCT
 - Regular monitoring for retinal vasculitis
 - Prompt referral for Tx of optic neuritis

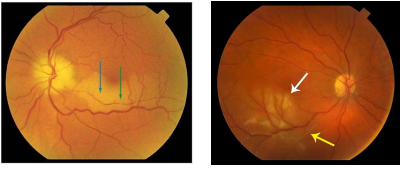




Source: <https://www.aafp.org/pubs/afp/issues/2002/0915/p991.html>


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Autoimmune Diseases

Systemic Lupus Erythematosus (SLE)

Retinal Vasculitis



Source: <https://www.aafp.org/pubs/afp/issues/2002/0915/p991.html>


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Autoimmune Diseases

Sjogren's Syndrome

Mainly affects females between 40 and 60 years old

Diagnosis is based on blood tests such as complete blood count (CBC), creatinine, erythrocyte sedimentation rate (ESR), and vitamin levels

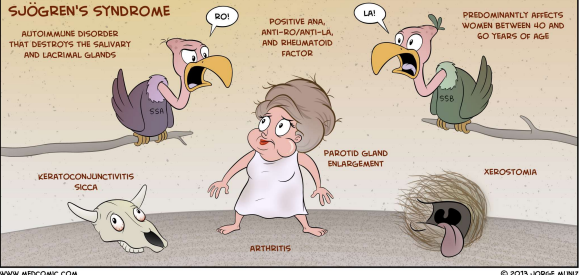


Source: Am Fam Physician. 2002;66(6):991-998

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Autoimmune Diseases

Sjogren's Syndrome



• Sjogren's syndrome is a chronic autoimmune inflammatory disorder that destroys the salivary and lacrimal glands, leading to persistent symptoms of dry mouth (xerostomia) and dry eyes (keratoconjunctivitis sicca).

• Parotid gland enlargement occurs in approximately one-third of patients.

• Sjogren's syndrome may occur alone as a primary form, or as a secondary form that complicates other diseases such as rheumatoid arthritis and systemic lupus erythematosus.

Source: <https://medscape.com>

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Autoimmune Diseases


Sjogren's Syndrome

Ocular Side Effects

- Severe dry eye
 - Dry eye precedes these findings on average by 1 decade
 - Patients with vision-threatening ocular findings were 3.9 times more likely to have systemic involvement. These can be peripheral neuropathy, interstitial nephritis, and vasculitis which were more common in those with vision threatening ocular findings
- Corneal ulcers
- Episcleritis
- Uveitis
- Peripheral ulcerative keratitis

Photo Source: <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>
Reference: Ophthalmology 2015;122:56-61

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Autoimmune Diseases


Sjogren's Syndrome

Ocular Side Effects

- Severe dry eye
 - Dry eye precedes these findings on average by 1 decade
 - Patients with vision-threatening ocular findings were 3.9 times more likely to have systemic involvement. These can be peripheral neuropathy, interstitial nephritis, and vasculitis which were more common in those with vision threatening ocular findings
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- Peripheral ulcerative keratitis

Photo Source: <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>
Reference: Ophthalmology 2015;122:56-61

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Hydroxychloroquine Treatment and Monitoring

It is used to treat:

- Systemic Lupus
- Rheumatoid Arthritis (RA)
- Discoid Lupus
- Sjogren's Syndrome

Source: <https://www.medicalnewstoday.com/articles/plaquenil>

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Hydroxychloroquine Treatment and Monitoring

Most Common Indications for Use:

- To help control inflammation and prevent flare-up in SLE
- Alleviate symptoms of joint pain and swelling in RA
- Helps manage severe dry eye and ocular inflammation

Source: <https://www.aafp.org/pubs/afp/issues/2002/09/15/p991.html>, <https://www.maxhealthcare.in/blogs/what-is-autoimmune-disease>, Am Fam Physician. 2002;66(6):991-998, <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>

●214




Hydroxychloroquine Treatment and Monitoring

Most Common Ocular Side Effects of Hydroxychloroquine:

- Corneal opacities
- Decrease in corneal sensation
- Decrease accommodation
- Posterior Subcapsular Cataract.
- Relative VF defects
- Decreased or Reduced Color Vision

Source: drugs.com, Ophthalmology 2015;122:56-61 10, <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>

●215



Hydroxychloroquine Treatment and Monitoring

Must test and evaluate for ocular side effects of both the autoimmune condition and those of the medications used for treatment

Source: drugs.com, Ophthalmology 2015;122:56-61 10, <https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/>

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Plaquénil® 200 mg

Hydroxychloroquine Treatment and Monitoring

Must test and evaluate for ocular side effects of both the autoimmune condition and those of the medications used for treatment

What technologies would be appropriate?

Source: drugs.com, Ophthalmology 2015;122:56-61 10, https://medsurgeindia.com/autoimmune-diseases-types-causes-treatment/

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Plaquénil® 200 mg

Hydroxychloroquine Treatment and Monitoring

Testing Protocols

Screening for Ocular Side Effects of Hydroxychloroquine

- SD-OCT – Spectral domain OCT
- FAF – Fundus Auto Fluorescence
- Visual Field – Threshold 10-2
- mfERG – Multifocal ERG
- Full Field ERG

Source: https://www.revieweducationgroup.com/e/time-to-update-your-plaquenil-screening-protocols

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Plaquénil® 200 mg

Hydroxychloroquine Treatment and Monitoring

Ganglion Cell OU Analysis: Macular Cube 200x200 OD OS

Source: https://www.northlakeeye.com/post/plaquenil-hydroxychloroquine-maculopathy-what-is-it-and-are-you-at-risk

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Plaquénil® 200 mg

Hydroxychloroquine Treatment and Monitoring

Source: https://www.northlakeeye.com/post/plaquenil-hydroxychloroquine-maculopathy-what-is-it-and-are-you-at-risk

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Plaquénil® 200 mg

Hydroxychloroquine Treatment and Monitoring

Source: https://waynep.blogspot.com/2012/06/hydroxychloroquine-retinopathy.html

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Autoimmune Diseases

Multiple Sclerosis

IMMUNE-MEDIATED INFLAMMATORY Demyelinating DISEASE OF THE CENTRAL NERVOUS SYSTEM

Source: https://medcomic.com

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Autoimmune Diseases

Multiple Sclerosis:

- People with MS may experience:
 - Paresthesias (tingling or numbness in the skin)
 - blurred vision
 - optic neuritis
 - clumsiness, muscle weakness
 - cognitive decline,
 - urinary dysfunction.
- The **Lhermitte sign** is elicited when neck flexion produces electric shock-like sensations down the back and limbs.

Source: <https://meddoomic.com>

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Hydroxychloroquine Treatment and Monitoring

What About?

- Fundus Photography**
- Amsler Grid**
- Extended Color Vision**
- ffERG**

Source: <https://www.revieweducationgroup.com/ce/time-to-update-your-plaquenil-screening-protocols>

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Autoimmune Diseases

Multiple Sclerosis:

- Is thought to occur as an immune-mediated attack on the central nervous system (CNS).
- The condition causes inflammation, demyelination, and axonal degeneration that can manifest through a wide variety of signs and symptoms.
- The age of onset for MS is usually between 15 and 50 years of age.
- It is the most common neurological disease-causing permanent disability in young adults and is thought to affect more than 2.3 million people worldwide.


Source: <https://meddoomic.com>

●225

Rheumatoid Arthritis

- **Ocular Conditions:** Dry eye, scleritis, uveitis
- **Latest Technology:** OCT, Anterior Segment OCT, Meibography
- **Evaluation Techniques:** Meibomian gland evaluation, anterior segment OCT for scleritis, and regular slit-lamp exams

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Autoimmune Diseases


Multiple Sclerosis

Ocular Side Effects

- Optic neuritis, retrobulbar neuritis, visual field defects
- internuclear ophthalmoplegia(improper lateral eye movements), dysmetria (abnormal coordination of movement) , nystagmus
- Color vision defects, blurred vision
- Diplopia (cranial nerve palsies)

Source: <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24618-internuclear-ophthalmoplegia>

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Autoimmune Diseases


Multiple Sclerosis

Testing

- Visual Fields Testing
- Extended Color Vision Testing
- OCT
- MRI
- Quantitative Pupillary testing
- EOM testing

Source: <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24618-internuclear-ophthalmoplegia>

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Autoimmune Diseases

Multiple Sclerosis

Testing

- Visual Fields Testing
- Extended Color Vision Testing
- OCT
- MRI
- Quantitative Pupillary testing
- EOM testing
- VEP – Visually Evoked Potential


Source <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24818-internuclear-ophthalmoplegia>

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Chronic Kidney Disease

- Ocular Conditions: Glaucoma, steroid-induced cataracts
- Latest Technology: OCT, Visual Field Testing
- Evaluation Techniques: Monitoring IOP, evaluating visual fields for glaucoma, and assessing optic nerve head with OCT

● 230



Autoimmune Diseases


Multiple Sclerosis

Testing Technologies

- Digital Color Vision Testing (ie Waggoner, Konan ColorDx)
- Sensory motor computerized testing (ie right eye)
- Digital pupillary testing (Konan Eyekinetix)

Source <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24818-internuclear-ophthalmoplegia>

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Autoimmune Diseases


Multiple Sclerosis

Testing Technologies

- Digital Color Vision Testing (ie Waggoner, Konan ColorDx)
- Sensory motor computerized testing (ie right eye)
- Digital pupillary testing (Konan Eyekinetix)

Source <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24818-internuclear-ophthalmoplegia>

● 232



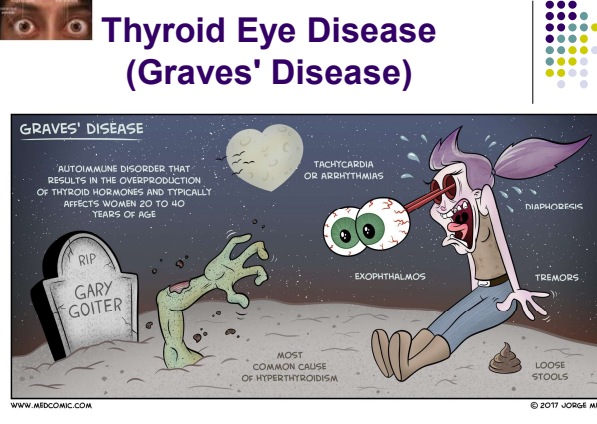
Autoimmune Diseases

Multiple Sclerosis

MS Case

Source <https://my.clevelandclinic.org/health/symptoms/25232-dysmetria>,
<https://my.clevelandclinic.org/health/diseases/24818-internuclear-ophthalmoplegia>

● 233



Thyroid Eye Disease (Graves' Disease)

GRAVES' DISEASE

AUTOIMMUNE DISORDER THAT RESULTS IN THE OVERPRODUCTION OF THYROID HORMONES AND TYPICALLY AFFECTS WOMEN 20 TO 40 YEARS OF AGE

TACHYCARDIA OR ARRHYTHMIAS

EXOPHTHALMOS

TREMORS

DIAPHORETIC

LOOSE STOOLS


MOST COMMON CAUSE OF HYPERTHYROIDISM

RIP GARY GOITER


WWW.MEDCOMIC.COM © 2017 JORGÉ AUNÍ

Source: www.medcomic.com

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Thyroid Eye Disease (Graves' Disease)




Ocular Symptoms of Graves' Disease


- Proptosis (bulging eyes)
- Periorbital edema (swelling around the eyes)
- Conjunctival injection (redness of the eye)
- Diplopia (double vision)
- Vision loss in severe cases

Source: <https://my.clevelandclinic.org/health/diseases/17558-thyroid-eye-disease>

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Thyroid Eye Disease (Graves' Disease)




- Thyroid eye disease (TED) and Graves' disease (GD) are related but distinct conditions.
- TED, also known as Graves' orbitopathy, is an autoimmune disorder of the orbit that is often associated with Graves' disease and chronic thyroiditis.
- Graves' disease is an autoimmune disorder that leads to hyperthyroidism and is often associated with ocular signs and symptoms

Source: <https://academic.oup.com/jes/article/8/1/bvad148/7452189>, <https://onlinelibrary.wiley.com/doi/pdf/10.1111/cen.14296>

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Thyroid Eye Disease (Graves' Disease)




- The prevalence of TED in the United States is approximately 250 per 100,000 persons
- Prevalence of Thyroid Eye Disease among Graves Disease patients is 40%, with geographical region-specific rates of 38% for Europe, 44% for Asia, 27% for North America, and 58% for Oceania.
- The annual incidence of TED in the United States' general population is reported to be 16 per 100,000 person-years in women and 3 per 100,000 person-years in men

Source: <https://academic.oup.com/jes/article/8/1/bvad148/7452189>, <https://doi.org/10.1210/jendo/bvad148>, <https://academic.oup.com/jes/article/8/1/bvad148/7452189>

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Thyroid Eye Disease (Graves' Disease)




Ocular Symptoms of Graves' Disease


- Proptosis (bulging eyes)
- Periorbital edema (swelling around the eyes)
- Conjunctival injection (redness of the eye)
- Diplopia (double vision)
- Vision loss in severe cases

Source: www.medcomic.com

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Thyroid Eye Disease (Graves' Disease)




Treatment options:
For Thyroid Eye Disease - include medications, lifestyle changes, and surgery.


- Medications may include eye drops, steroids, and other drugs to reduce inflammation.
- Lifestyle changes such as quitting smoking can help.
- In severe cases, surgery may be necessary to correct eye alignment or reduce pressure on the optic nerve

Source: <https://my.clevelandclinic.org/health/diseases/17558-thyroid-eye-disease>

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Thyroid Eye Disease (Graves' Disease)




Treatment options: What about Tepezza?
(teprotumumab-trbw)
Indicated For Thyroid Eye Disease

- For reducing symptoms such as eye bulging, double vision, eye pain, redness, and swelling
- Works by blocking a protein called IGF-1R (insulin-like growth factor-1 receptor) to reduce swelling behind the eye, treating the cause of TED rather than just the symptom

Source: <https://www.drugs.com/tepezza.html>

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Thyroid Eye Disease (Graves' Disease)


Treatment options: What about Tepezza? (teprotumumab-trbw)

Side Effects

- Muscle spasms, nausea, diarrhea, headache, tiredness, high blood sugar, hair loss, hearing problems, and dry skin. Serious side effects may include allergic reactions, worsening of inflammatory bowel disease, and increased blood sugar

Source: <https://www.drugs.com/tepezza.html>

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Thyroid Eye Disease (Graves' Disease)

Treatment options: What about Tepezza? (teprotumumab-trbw)


-It is administered as an **intravenous (IV) infusion**. The preparation involves reconstituting the a powder with sterile water for injection, diluting the solution in an IV infusion bag, and then infusing it over a specified

Initial dose: 10 mg/kg IV

Subsequent doses: 20 mg/kg IV every 3 weeks for 7 additional infusions

Source: <https://reference.medscape.com/drug/tepezza-teprotumumab-4000026>

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Thyroid Eye Disease (Graves' Disease)

- Recognizing and managing thyroid-related ocular changes
- Initial assessment – includes a thorough history and clinical examination for assessment of severity and Thyroid Eye Disease activity.
- Follow-up every 4 to 6 months or more frequently if the disease is active
- Coordination of care with endocrinologists

Source: <https://www.aaopt.org/eyenet/article/consensus-on-treating-thyroid-eye-disease>, <https://www.medcentral.com/ophthalmology/which-assessment-should-be-completed-at-thyroid-eye-disease-maintenance>

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Thyroid Eye Disease (Graves' Disease)

Testing and Evaluation

- Visual Acuity every visit
- Extended Color Vision Testing – to help detect optic neuropathy at every visit.
- Pupil Testing to evaluate optic nerve involvement every visit
- Extraocular Mobility Testing every visit
- Exophthalmometry every visit
- IOP measurement

Source: <https://www.aaopt.org/eyenet/article/consensus-on-treating-thyroid-eye-disease>, <https://www.medcentral.com/ophthalmology/which-assessment-should-be-completed-at-thyroid-eye-disease-maintenance>

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Thyroid Eye Disease (Graves' Disease)


Testing and Evaluation

- Slit-lamp examination every visit
- Fundus Examination every visit
- Imaging – Orbital CT or MRI as needed

Coordination of care with endocrinologists

Source: <https://www.aaopt.org/eyenet/article/consensus-on-treating-thyroid-eye-disease>, <https://www.medcentral.com/ophthalmology/which-assessment-should-be-completed-at-thyroid-eye-disease-maintenance>

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Thyroid Eye Disease (Graves' Disease)

Technologies Recommended

- OCT
- Fundus Photography
- Ultrasound Biomicroscopy for high resolution images of the anterior segment and useful for assessing extent of muscle involvement
- Tech options: Eyekinetics, OCT with ganglion cell analysis and angiography, Digital color vision testing

Patient management

- Coordination of care with endocrinologists

Source: <https://www.aaopt.org/eyenet/article/consensus-on-treating-thyroid-eye-disease>, <https://www.medcentral.com/ophthalmology/which-assessment-should-be-completed-at-thyroid-eye-disease-maintenance>

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Thyroid Eye Disease (Graves' Disease)

- Recognizing and managing thyroid-related ocular changes
- Coordination of care with endocrinologists

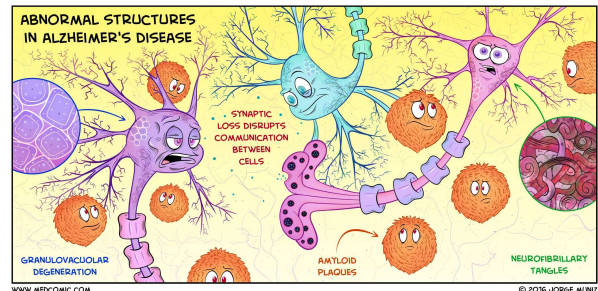
Management of Thyroid Eye Disease: A Consensus Statement by the American Thyroid Association and the European Thyroid Association

Source: <https://www.aao.org/eyenet/article/consensus-on-treating-thyroid-eye-disease>

● 247



Alzheimer's Disease



Source: <https://mediacomic.com>

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Alzheimer's Disease

- Dementia is a general term for a decline in cognitive function severe enough to interfere with daily life activities. Symptoms affect memory, thinking, and social abilities.
- Alzheimer's disease is the most common type of dementia, showing progressive memory loss and cognitive decline due to amyloid plaques and tau tangles accumulation in the brain.

Source: <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/expert-answers/alzheimers-and-dementia-whats-the-difference/faq-20396861>

● 249



Alzheimer's Disease

- Alzheimer's Disease is a neurodegenerative disorder and the most common cause of dementia.
- Abnormal cellular structures lead to a loss of synapses and neurons, which results in atrophy of the brain.
- There are several characteristic abnormalities found in the brain tissue that include excessive granulo vacuoles, amyloid plaques, and neurofibrillary tangles. Amyloid plaques form outside of neurons when protein pieces called beta-amyloid clump together.
- The plaques block cell-to-cell signaling at synapses and may trigger processes that lead to nerve cell death. Neurofibrillary tangles are abnormal collections of protein threads inside the nerve that twist around each other

Source: <https://mediacomic.com>

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Alzheimer's Disease

Effects on the Visual System

- Visual Spatial Perception – judging distances and spatial relationships.
- Contrast Sensitivity
- Motion Perception
- Reading Difficulties – impaired visual processing
- Visual changes and challenges in dementia patients
- Retinal Changes due to accumulation of amyloid plaques in the retina.

Source: <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/expert-answers/alzheimers-and-dementia-whats-the-difference/faq-20396861>

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Alzheimer's Disease

Special Testing

- Optical Coherence Tomography (OCT) – detect and quantify thinning of retinal nerve fiber layer
- Extended Color Vision Testing
- Retinal Photography – detection of amyloid plaques
- Full Field Electroretinography (ffERG) – assesses functional integrity of the retina

Source: <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/expert-answers/alzheimers-and-dementia-whats-the-difference/faq-20396861>

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Alzheimer's Disease

Frequency of Screening and Testing

- At diagnosis for baseline
- Annual testing or more frequently if significant changes are detected
- High Risk Patients show rapid progression of symptoms or significant ocular findings
- More frequent monitoring and testing per individual risk factors

Source: <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/expert-answers/alzheimers-and-dementia-what-s-the-difference/faq-20396861>

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Alzheimer's Disease

This is a specialized image of the retina showing multiple deposits of amyloid. The deposits in the early stages can lead to vision loss.

Source: <https://www.aao.org/eye-health/diseases/alzheimers-disease-dementia-eye> <https://www.mayoclinic.org/diseases-conditions/alzheimers-disease/expert-answers/alzheimers-and-dementia-what-s-the-difference/faq-20396861>

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Alzheimer's Disease

Advice an Optometrist can give to reduce risk

- Mediterranean Diet – a diet that emphasizes fruits, vegetables, whole grains, fish, and healthy fats (olive oil)
- Physical active lifestyle to improve cognitive function
- Cognitive Engagement – puzzles, reading and learning new skills

Source: National Institute on Aging-Combination of Healthy lifestyle traits, Harvard Gazette-Alzheimer's study

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Alzheimer's Disease

Links with Alzheimer's and other conditions

- Diabetes due to insulin resistance and inflammation
- Hypertension due to damaged blood vessels in the brain contributing to cognitive decline
- Processed Foods
- Artificial sweeteners

Source: Harvard Gazette-Alzheimer's study, Healthline-Alzheimer's Diet and Nutrition Guide, Harvard Health-Cold Artificial Sweeteners be bad for your brain?

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Chronic Kidney Disease

Chronic Kidney Disease (CKD) is a long-term condition characterized by a gradual loss of kidney function over time. The kidney's ability to filter waste products from the blood diminishes, leading to the accumulation of toxins and fluids in the body.

- Advanced chronic kidney disease can cause dangerous levels of fluid, electrolytes and wastes to build up in your body.

Source: <https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease

Chronic Kidney Disease (CKD) CKD is classified into five stages based on the glomerular filtration rate (GFR), with Stage 1 being mild and Stage 5 indicating kidney failure.

GFR can range ≥ 90 for normal to <15 for kidney failure

Source: <https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Chronic Kidney Disease (CKD) Stage Classifications

- Stage 1: Kidney damage with normal or increased GFR - ≥ 90
- Stage 2: Mild reduction in GFR. GFR 60-89. there may be evidence of kidney damage
- Stage 3: Moderate Reduction in GFR. GFR 30-59 with subdivisions
 - 3a – GFR 45-59
 - 3b – GFR 30-44
- Stage 4: Severe Reduction in GFR. GFR 15-29
 - Preparation for renal replacement therapy(dialysis or transplant)
- Stage 5: Kidney failure. GFR <15
 - Kidneys no longer able to function adequately to maintain health. Dialysis or transplant is necessary

Source: <https://www.uptodate.com/contents/definition-and-staging-of-chronic-kidney-disease-in-adults>

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Chronic Kidney Disease



Most Common Causes of CKD

Diabetes (Diabetic Nephropathy)

Description: High blood glucose levels can damage the blood vessels in the kidneys, leading to impaired kidney function.

Prevalence: The leading cause of CKD, accounting for nearly 40% of all cases.

Source:<https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Most Common Causes of CKD

Hypertension (High Blood Pressure)

Description: High blood pressure can damage the blood vessels in the kidneys, reducing their ability to function properly.

Prevalence: The second leading cause of CKD23.

Hypertension (High Blood Pressure)

Source:<https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Most Common Causes of CKD

Glomerulonephritis

Description: Inflammation of the glomeruli, the tiny filters in the kidneys, which can lead to scarring and loss of kidney function.

Prevalence: A significant cause of CKD3.

Source:<https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Most Common Causes of CKD

Polycystic Kidney Disease (PKD)

Description: A genetic disorder characterized by the growth of numerous cysts in the kidneys, leading to enlarged kidneys and reduced function.

Prevalence: A common inherited cause of CKD3.

Source:<https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Most Common Causes of CKD

Chronic Pyelonephritis

Description: Recurrent kidney infections that can cause scarring and damage to the kidneys over time.

Prevalence: A less common cause of CKD3.

Source:<https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Ocular Signs of Chronic Kidney Disease CKD

Hypertensive Retinopathy

Description: Damage to the retinal blood vessels due to high blood pressure, common in CKD patients.

Signs: Arteriolar narrowing, arteriovenous (AV) nicking, retinal hemorrhages, cotton wool spots, and optic disc edema

Source: <https://www.reviewofoptometry.com/article/the-eye-kidney-connection>

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Chronic Kidney Disease



Ocular Signs of Chronic Kidney Disease CKD

Retinal Vein Occlusion

Description: Blockage of the retinal veins, leading to vision loss.

Signs: Retinal hemorrhages, macular edema, cotton wool spots.

Source: <https://www.mayoclinic.org/diseases-conditions/chronic-kidney-disease/symptoms-causes/syc-20354521>

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Chronic Kidney Disease



Ocular Signs of Chronic Kidney Disease CKD

Uremic Optic Neuropathy

Description: Damage to the optic nerve due to high levels of urea in the blood.

Signs: Optic disc edema, vision loss.

Source: https://applications.emro.who.int/imemrf/Egypt_J_Hosp_Med/Egypt_J_Hosp_Med_2018_72_11_5640_5646.pdf

●267



Chronic Kidney Disease



Ocular Signs of Chronic Kidney Disease CKD

Band Keratopathy



Description: Calcium deposits in the cornea.

Signs: White, opaque bands across the cornea.

Source: https://applications.emro.who.int/imemrf/Egypt_J_Hosp_Med/Egypt_J_Hosp_Med_2018_72_11_5640_5646.pdf

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Chronic Kidney Disease



Ocular Signs of Patients on Dialysis

Dry Eye Syndrome

Description: Reduced tear production and increased tear evaporation.

Signs: Dry, red, and sore eyes that feel gritty.

Source: <https://www.kidney.org/news-stories/kidney-disease-dialysis-and-your-eyes>

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Chronic Kidney Disease



Ocular Signs of Patients on Dialysis

Conjunctival Pallor

Description: Pale appearance of the conjunctiva due to anemia.

Signs: Pale conjunctiva.

Source: <https://academic.oup.com/ckj/article/7/4/337/779006?login=false>

●270



Chronic Kidney Disease



Ocular Signs of Patients on Dialysis

Increased Intraocular Pressure (IOP)

Description: Elevated pressure inside the eye, potentially leading to glaucoma.

Signs: Elevated IOP readings

Source: <https://www.kidney.org/news-stories/kidney-disease-dialysis-and-your-eyes>

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Chronic Kidney Disease



Ophthalmic Evaluation Protocols

Baseline Examination

Timing: At diagnosis of CKD or initiation of dialysis.

Tests: Comprehensive eye exam, including visual acuity, intraocular pressure measurement, slit-lamp examination, and dilated fundus examination.

Source: <https://www.kidney.org/news-stories/kidney-disease-dialysis-and-your-eyes>

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Chronic Kidney Disease



Ophthalmic Evaluation Protocols

Regular Monitoring

Frequency: Every 6-12 months, or more frequently if ocular signs are present.

Tests: Repeat comprehensive evaluation.

Source: <https://www.kidney.org/news-stories/kidney-disease-dialysis-and-your-eyes>

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Chronic Kidney Disease



Special Testing

Optical Coherence Tomography (OCT):

To assess retinal thickness and detect macular edema or retinal nerve fiber layer thinning.

Source: <https://www.kidney.org/sites/default/files/Final%20Session%201%20Ottoman%20Guide%20to%20CKD%20Screening%20and%20Evaluation.pdf>

●274



Chronic Kidney Disease



Special Testing

Extended Color Vision Testing:

To detect changes in color perception, which can be an early sign of optic neuropathy.

Source: <https://www.kidney.org/sites/default/files/Final%20Session%201%20Ottoman%20Guide%20to%20CKD%20Screening%20and%20Evaluation.pdf>

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Chronic Kidney Disease



Special Testing

Retinal Photography:

To document retinal changes and monitor progression over time.

Source: <https://www.kidney.org/sites/default/files/Final%20Session%201%20Ottoman%20Guide%20to%20CKD%20Screening%20and%20Evaluation.pdf>

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Chronic Kidney Disease



Special Testing

Full-Field Electroretinography (ERG):

To assess the functional integrity of the retina.

Source: <https://www.kidney.org/sites/default/files/Final%20Session%201%20Ottoman%20Guide%20to%20CKD%20Screening%20and%20Evaluation.pdf>

●277



Stroke



Stroke Defined

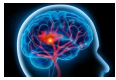
A stroke occurs when the blood supply to part of the brain is interrupted or reduced, preventing brain tissue from getting enough oxygen and nutrients. Brain cells begin to die within minutes. There are two main types of stroke:

Ischemic Stroke: Caused by a blockage in an artery supplying blood to the brain.

Hemorrhagic Stroke: Caused by a blood vessel in the brain leaking or bursting

Source: <https://www.mayoclinic.org/diseases-conditions/stroke/symptoms-causes/syc-20350113>

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Stroke



Ophthalmic Conditions Post Stroke

Visual Field Loss

Description: Loss of vision in a specific area of the visual field.

Types: Hemianopia (loss of half the visual field), quadrantanopia (loss of a quarter of the visual field).

Source: <https://www.aaopt.org/eye-health/tips-prevention/strokes-effect-on-vision>

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Stroke



Ophthalmic Conditions Post Stroke

Diplopia (Double Vision)

Description: Seeing two images of a single object.

Cause: Misalignment of the eyes due to muscle or nerve damage.

Source: <https://www.aaopt.org/eye-health/tips-prevention/strokes-effect-on-vision>

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Stroke



Ophthalmic Conditions Post Stroke

Nystagmus

Description: Rapid, uncontrolled eye movements.

Cause: Damage to the brain areas controlling eye movements.

Source: <https://www.optometrists.org/vision-therapy/neuro-optometry/vision-and-brain-injuries/traumatic-brain-injury-and-neuro-optometry/can-a-stroke-cause-vision-problems/stroke-recovery-and-neuro-optometry/>

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Stroke



Ophthalmic Conditions Post Stroke

Dry Eye Syndrome

Description: Reduced tear production or increased tear evaporation.

Cause: Incomplete eyelid closure due to facial muscle weakness.

Source: <https://www.optometrists.org/vision-therapy/neuro-optometry/vision-and-brain-injuries/traumatic-brain-injury-and-neuro-optometry/can-a-stroke-cause-vision-problems/stroke-recovery-and-neuro-optometry/>

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Stroke



Ophthalmic Conditions Post Stroke

Visual Neglect

Description: Ignoring one side of the visual field.

Cause: Damage to the brain's visual processing areas.

Source: <https://www.nrb.org.uk/your-eyes/eye-conditions-az/stroke-related-eye-conditions/>

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Stroke



Exam Protocols for Stroke Patients

Initial Assessment

- History: Document stroke-related signs and symptoms.
- Visual Acuity: Measure best-corrected visual acuity.
- Pupil Reflexes: Check for abnormal pupil responses.
- Cover Test: Assess for ocular misalignment.
- Ocular Motility: Evaluate eye movement range.
- Dilated Fundus Examination: Assess retina and optic nerve

Source: <https://www.optometrytimes.com/view/how-care-stroke-patients>

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Stroke



Exam Protocols for Stroke Patients

Special Testing

- Visual Field Testing: Perform threshold visual field testing to detect field loss.
- Optical Coherence Tomography (OCT)
 - Purpose: Assess retinal thickness and detect macular edema or retinal nerve fiber layer thinning.
- Color Fundus Photography
 - Purpose: Document the retina and optic nerve for baseline and follow-up comparisons.

Source: <https://my.clevelandclinic.org/health/diseases/24127-eye-stroke>

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Stroke



Prevalence and Causes of Stroke in the US

- Every year, more than 795,000 people in the United States have a stroke. About 610,000 of these are first or new strokes.
- Of these, about 137,000 people die from stroke annually
- Around 185,000 strokes each year occur in people who have previously had a stroke.
- The survival rate depends on the type of stroke, with ischemic strokes generally having a higher survival rate compared to hemorrhagic strokes.

Source: <https://www.cdc.gov/stroke/data-research/facts-stats/index.html>

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Stroke



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Source: <https://www.cdc.gov/stroke/data-research/facts-stats/index.html>
<https://www.verywellhealth.com/stroke-survival-rate-5213990>

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Stroke




Death Rate:

- The death rate for stroke decreased from 41.1 per 100,000 in 2021 to 39.5 per 100,000 in 2022.
- Stroke is the fifth leading cause of death in the United States.

Source: <https://www.cdc.gov/stroke/data-research/facts-stats/index.html>
<https://www.verywellhealth.com/stroke-survival-rate-5213990>

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
Sleep Apnea

Sleep Apnea Defined
 Sleep apnea is a sleep disorder characterized by repeated interruptions in breathing during sleep. These interruptions, known as apneas, can last from a few seconds to minutes and occur multiple times per hour. There are two main types:

- **Obstructive Sleep Apnea (OSA):** Caused by a blockage of the airway, usually when the soft tissue in the back of the throat collapses during sleep.
- **Central Sleep Apnea (CSA):** Occurs when the brain fails to send proper signals to the muscles that control breathing.

Source: <https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631>

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Sleep Apnea

Sleep Apnea Prevalence

Prevalence: Approximately 30 million people in the United States are affected by sleep apnea, with about 6 million diagnosed cases.

Source: <https://www.ncoa.org/adviser/sleep/sleep-apnea-statistics/>

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
Sleep Apnea

Sleep Apnea Causes

Obesity: Excess weight increases the risk of airway obstruction.
Age: Risk increases with age.
Gender: More common in men than women.
Family History: Genetic predisposition to sleep apnea.
Alcohol and Smoking: Both can increase the risk of airway collapse during sleep

Source: <https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631>

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Sleep Apnea


Ophthalmologic Exam Protocols for Sleep Apnea

Initial Assessment

- **History:** Document sleep apnea-related signs and symptoms.
- **Visual Acuity:** Measure best-corrected visual acuity.
- **Pupil Reflexes:** Check for abnormal pupil responses.
- **Cover Test:** Assess for ocular misalignment.
- **Ocular Motility:** Evaluate eye movement range.
- **Dilated Fundus Examination:** Examine the retina and optic nerve for signs of damage.
- **Tonometry**

Source: <https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631>

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Sleep Apnea

Special Testing for Sleep Apnea

Visual Field Testing: Perform threshold visual field testing to detect field loss.
Optical Coherence Tomography (OCT)

- **Purpose:** Assess retinal thickness and detect macular edema or retinal nerve fiber layer thinning.

Color Fundus Photography


- **Purpose:** Document the retina and optic nerve for baseline and follow-up comparisons.

Corneal Pachymetry

- **Purpose:** To assess glaucoma risk

Source: <https://www.mayoclinic.org/diseases-conditions/sleep-apnea/symptoms-causes/syc-20377631>, <https://retinatoday.com/articles/2017-sept/the-eye-as-a-window-for-early-diagnosis-of-obstructive-sleep-apnea>

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Cancer

Cancers with Ocular Signs

Breast Cancer
 Ocular Signs: Metastasis to the eye can cause uveitis, retinal detachment, and optic neuropathy.

Lung Cancer
 Ocular Signs: Can lead to Horner's syndrome, ptosis, and enophthalmos due to metastasis.


Leukemia
 Ocular Signs: Retinal hemorrhages, cotton wool spots, and optic nerve infiltration.

Lymphoma
 Ocular Signs: Can cause orbital tumors, conjunctival masses, and uveitis1.

Melanoma
 Ocular Signs: Uveal melanoma, conjunctival melanoma, and metastasis to the orbit.

Source: <https://www.mdanderson.org/cancer-types/eye-cancer/eye-cancer-symptoms.html>

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Cancer

Ocular Signs of Common Cancer Treatments and Drugs

Chemotherapy
Ocular Signs: Dry eye syndrome, conjunctivitis, keratitis, and cataracts.


Radiation Therapy
Ocular Signs: Radiation retinopathy, optic neuropathy, and cataracts.

Targeted Therapy
Ocular Signs: Retinal vein occlusion, uveitis, and macular edema.

Immunotherapy
Ocular Signs: Uveitis, dry eye syndrome, and optic neuritis.

Source: <https://consultqd.clevelandclinic.org/eye-toxicities-more-prevalent-side-effect-of-cancer-treatment-than-previously-understood>

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Cancer

Exam Protocols for Cancer Patients

Initial Assessment

History: Document cancer diagnosis, treatments, and ocular symptoms.

Visual Acuity: Measure best-corrected visual acuity.


Pupil Reflexes: Check for abnormal pupil responses.

Ocular Motility: Evaluate eye movement range.

Dilated Fundus Examination: Examine the retina and optic nerve for signs of damage.

Source: <https://med.virginia.edu/ophthalmology/wp-content/uploads/sites/295/2015/12/Systemic.pdf>

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Cancer


Optical Coherence Tomography (OCT)
Purpose: Assess retinal thickness and detect macular edema or retinal nerve fiber layer thinning.

Color Fundus Photography
Purpose: Document the retina and optic nerve for baseline and follow-up comparisons.

Electroretinography (ERG)
Purpose: Assess the functional integrity of the retina.

Source: <https://med.virginia.edu/ophthalmology/wp-content/uploads/sites/295/2015/12/Systemic.pdf>

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Autism

Autism Defined

- Autism spectrum disorder (ASD) is a neurological and developmental disorder that affects how people interact with others, communicate, learn, and behave
- It can be diagnosed at any age but considered a “developmental disorder” because symptoms generally appear in the first 2 years of life
- Termed a “spectrum” disorder because there is wide variation in the type and severity of symptoms people experience

Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?spec=1>
<https://www.nlm.nih.gov/health/publications/autism-spectrum-disorder>

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Autism

- Children with Autism are more likely to have vision problems
- Autism is unusually common among blind people. Double-digit prevalence of autism among blind children
- Research suggests specific causes of blindness
 - Retinopathy of prematurity
 - Optic nerve hypoplasia
 - Anophthalmia (in which one or both eyes fail to develop)

Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?spec=1>
<https://www.nlm.nih.gov/health/publications/autism-spectrum-disorder>

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Autism

- Children with Autism are more likely to have vision problems
- Vision is thought to be critical to the early development of social skills
- Children learn about social cause and effect through visual relationships.....ie. The concept of “Mine”
 - Those who are born blind may have trouble gaining it in the first place
 - Children with acquired blindness can still tap this knowledge after they have lost their sight

Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?spec=1>
<https://www.nlm.nih.gov/health/publications/autism-spectrum-disorder>

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Autism

- Making little or inconsistent eye contact
- Appearing not to look at or listen to people who are talking
- Not responding or being slow to respond to one's name or to other verbal bids for attention
- Having difficulties with the back and forth of conversation
- Displaying facial expressions, movements, and gestures that do not match what is being said
- Having an unusual tone of voice that may sound sing-song or flat and robot-like
- Difficulties adjusting behaviors to social situations

Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?fspec=1>
<https://www.nimh.nih.gov/health/publications/autism-spectrum-disorder>

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Autism

Optometric Evaluation

- May need to depend heavily on objective findings
 - With or without cyclopegia Retinoscopy, Autorefraction
- Adjust testing to what the patient will allow
- Consider electrodiagnostic test (fullfield ERG) to assess retinal health and integrity
- Consider low vision referral when vision impairment is suspected
- Consider referral for other Autism care resources in the area.

Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?fspec=1>
<https://www.nimh.nih.gov/sites/default/files/documents/healthpublications/autism-spectrum-disorder/22-MH-6084-Autism-Spectrum-Disorder.pdf>

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Autism

Common Ocular Conditions

- Strabismus (misaligned eyes)
- Amblyopia (lazy eye)
- Glare sensitivity
- Visual processing disorders
- Eye tracking disorders

Diagnostic Tools and Techniques

- Visual Evoked Potentials (VEP)
- Electroretinography (ERG)
- Functional MRI (fMRI)


Source: <https://www.thetransmitter.org/spectrum/eyeing-the-connection-between-autism-and-vision/?fspec=1>
<https://www.nimh.nih.gov/health/publications/autism-spectrum-disorder>

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Change is the essential process of all existence.

-Spock

Questions?



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