

## Carotenoid Levels in Ocular Disease and Systemic Health

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### Disclosures- Greg Caldwell, OD, FAAO

- The content of this activity was prepared independently by me - Dr. Caldwell
- Lectured for: Alcon, Allergan, Aerie, BioTissue, Kala, Maculogix, Optovue, RVL, Heru
- Advisory Board: Allergan, Sun, Alcon, Maculogix, Dompe, Visus, Eyenovia
- Envelope: PA Medical Director, Credential Committee
- Healthcare Registries - Chairman of Advisory Council for Diabetes
- I have no direct financial or proprietary interest in any companies, products or services mentioned in this presentation
- Disclosure: carotenoid Phamanex scanner owner, Maculogix owner, Optovue OCT and OCT-A owner
- The content and format of this course is presented without commercial bias and does not claim superiority of any commercial product or service
- Optometric Education Consultants - Scottsdale, AZ, Orlando, FL, Mackinac Island, MI, Nashville, TN, and Quebec City, Canada - Owner



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## Agenda

Thanks for the Opportunity

- ✓ My ocular disease focus to prevention
- ✓ Ocular diseases from oxidative stress
- ✓ Evidence based medicine proves antioxidant intervention
- ✓ Measuring carotenoids
- ✓ Phospholipid bilayer membrane - damage and protection
- ✓ Partial versus total supplementation
  - \* Inner and outer retina
  - \* Ocular supplements or full body

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## Optometry Recommendation

- ✓ DHA/EPA
- ✓ Omega 3 or 6
- ✓ Lutein
- ✓ Zeaxanthin
- ✓ Lutein/Zeaxanthin
- ✓ AREDS2
- ✓ AREDS2 with anti-VEGF

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## Medical Practices

- ✓ Allopathic medicine
  - \* Western medicine
- ✓ Alternative "homeopathic"
- ✓ Functional
  - \* Medicine of why, treat the cause
- ✓ Integrative medicine
  - \* Complementary medicine - Eastern complimenting Western

What is integrative medicine?

The practice of integrative medicine refers to the blending of conventional and evidence-based natural and complementary medicines and/or therapies with lifestyle interventions to deliver holistic, patient-centred care.

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## Ocular Disease Career

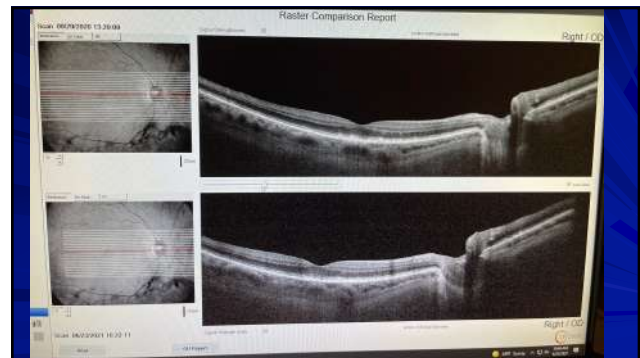
- ✓ OCT - Spectral domain
- ✓ OCT Angiography
- ✓ Visual Fields
- ✓ AMD, glaucoma, retinal degenerations, diabetic retinopathy
- ✓ Dark Adaptation
- ✓ Focusing on structure and function loss or damage
- ✓ Patients asking what about supplements
  - \* Reading about it on internet
  - \* Promised I would do my due diligence
- ✓ Ocular disease optometrist to an Integrative Optometrist



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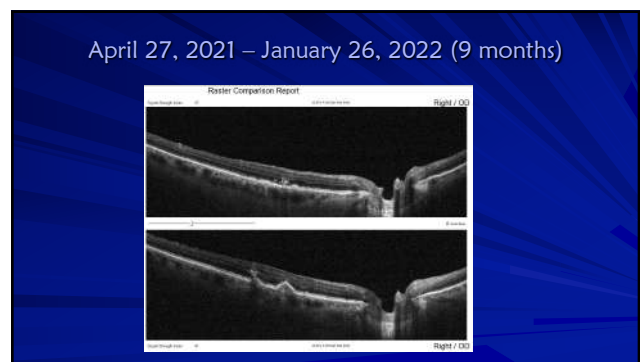
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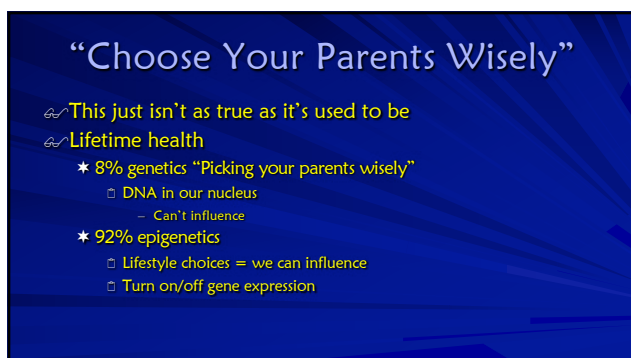
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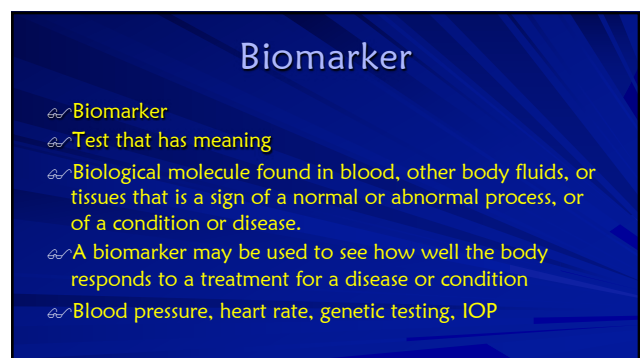
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## Predictive Biomarker

- Used to identify individuals who are more likely to respond to exposure to a particular medical product or environmental agent
- The response could be a symptomatic benefit, improved survival, or an adverse effect
- A value that we can guide therapy around
  - HbA1c
  - C-Reactive Protein
  - Plasma Homocysteine
  - Vitamin D (25-HydroxyD)
  - Omega 3 index
  - Carotenoid

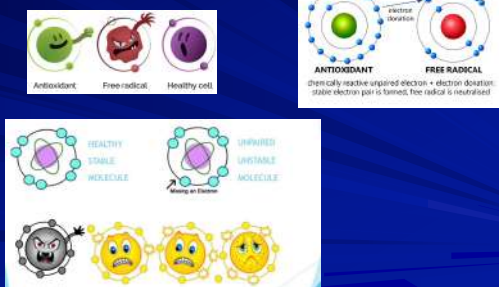
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## Question

- Do you agree that free radical formation is a progressive process that leads to cell damage or death?
  - Yes
  - No

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## Free Radicals and Antioxidants



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## Oxidative Stress

- Small percentage of oxygen is not completely reduced
- Accumulation of free radicals
- Oxidative damage
- Oxidative stress
- Considered the starting of several diseases
- Responsible for epigenetic alterations
- Mitochondria – vulnerable
- Not going to make this apple new again
  - Prevention is the one of the best medicines



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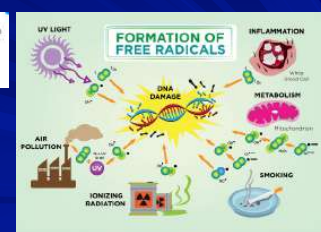
## Free Radicals

- During metabolism the  $O_2$  molecule splits and energy is released
  - Endogenous free radical formation
- Regain stability the free single oxygen atom (oxygen free radical) seeks and steals electrons from other molecules
  - Superoxide anion – will accept one electron
  - Peroxide – will accept two electrons
- These molecules can be proteins, lipids, and DNA
  - Proteins (enzymes) – kinases, phosphatases, and transcription factors

Reactive oxygen species (• = unpaired electrons)				
$O_2$	$•O_2$	$O_2^{•-}$	$HO_2•$	$HO_2•$
Oxygen	Superoxide anion	Peroxide	Hydroxyl radical	Hydroxyl ion
			$•OH$	$OH^-$

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## Endogenous and Exogenous Free Radical Formation



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## Oh no

- ~ Increasing exogenous free radicals
- ~ Less antioxidant protection in our diet
- ~ More bad and less good



Is an orange of the 1950's equivalent to 21 of today's oranges?

An orange from the 1950's was full of vitamin A, precious for our sight and our immune defenses. To attain the same amounts today, you would have to consume 21 of them. Onions and potatoes no longer contain any trace of it. The Iron content in meat? Divided by 2. Calcium in broccoli? Divided by 4. To ingest the vitamin C contained in an apple from yesteryear, you would have to eat 100 today.

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## The Equalizer




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## October 23, 2021




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## October 23, 2021



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## M Lounge



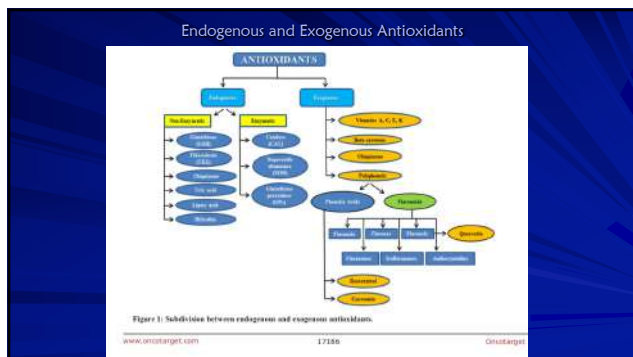


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## Nutritional Antioxidants

- ~ Exogenous antioxidants
  - \* Tocopherols (E), ascorbic acid (C), carotenoids, ubiquinone, and polyphenols
- ~ Well know antioxidants
  - \* Vitamin C, E, Beta-carotene, lutein, zeathanin, selenium, quercetin, and resveratrol
- ~ Mechanisms of action;
  - \* Neutralize free radicals
  - \* Repair oxidized membranes
  - \* Decrease reactive oxygen species
  - \* Neutral reactive oxygen species

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## Carotenoids

- Organic pigments produced by plants, algae, and bacteria
- Cannot be synthesized by the human body
  - Hydrophobic compounds
    - Important for the phospholipid bilayer
- 600 in nature – 50 human food chain – 15-20 human blood stream
- Macular carotenoids (L and Z) – highest concentration found in the human body
  - Diet derived
  - Henle fibers – between the inner and outer plexiform layers
  - Sequester or absorb blue light

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## Question

Do you measure carotenoid levels in your office?

- Yes
- No

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## Measure?

ANNUAL REVIEW

Assessment of Carotenoid Biomarkers

Recent carotenoid biomarker research has focused on the use of carotenoids as biomarkers for disease risk and health status. The use of carotenoids as biomarkers is based on the fact that carotenoids are important components of the human diet and are known to have antioxidant and anti-inflammatory properties. The use of carotenoids as biomarkers is also based on the fact that carotenoids are known to be associated with various health outcomes, including cardiovascular disease, cancer, and age-related macular degeneration. The use of carotenoids as biomarkers is a promising area of research, and further studies are needed to establish the validity of carotenoid biomarkers for disease risk and health status.

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## Significance of Carotenoids

High blood levels of the carotenoid alpha-carotene may reduce the risk of dying from cardiovascular disease (CVD), cancer, and all other causes by up to 39 percent.

AREDS 2: Higher dietary intake of lutein/zeaxanthin was independently associated with decreased risk of having neovascular AMD and large or extensive drusen.

Plasma carotenoid levels and cognitive performance in an elderly population: results of the EVA study.

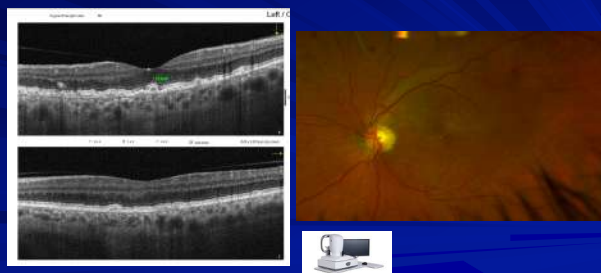
Oxidative stress in rheumatoid arthritis patients: relationship with carotenoid levels.

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## Oxidative Stress with Your OCT

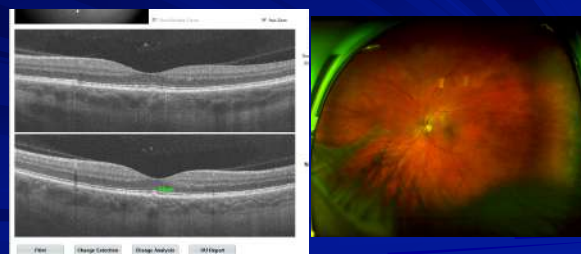
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### Oxidative Stress with Your OCT



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### Oxidative Stress with Your OCT



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### Healthy choriocapillaris, Bruch's, RPE, and Photoreceptors



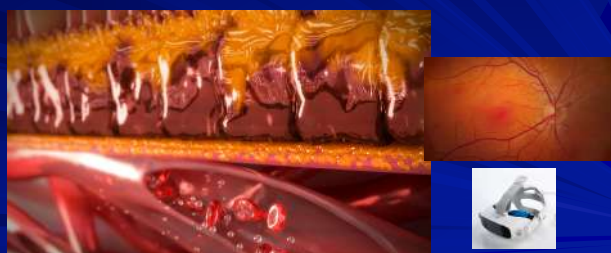
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### Cholesterol barrier deposited along Bruch's and RPE



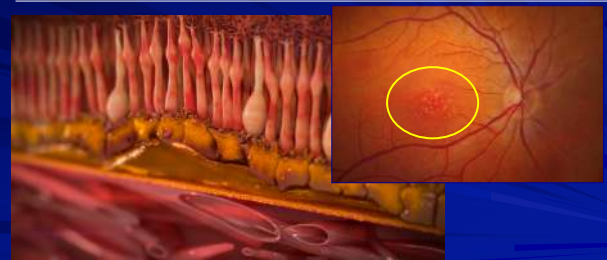
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### RPE Secretes even more cholesterol and degenerates



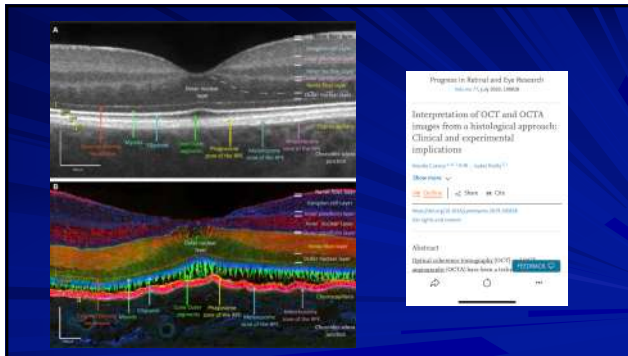
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### Finally, visibly evident drusen on fundus evaluation

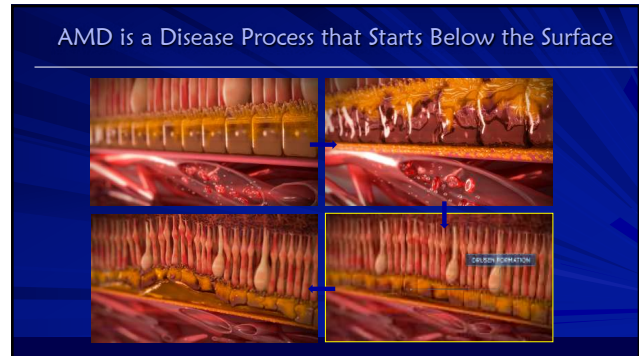


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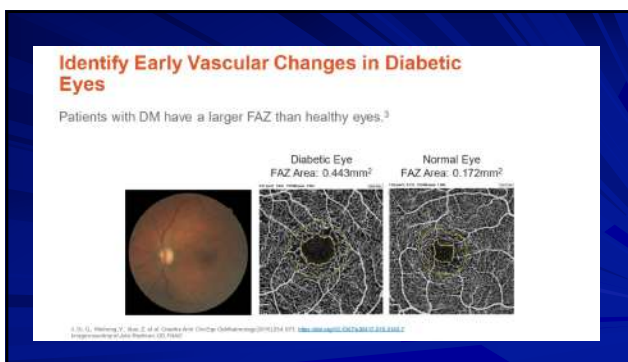




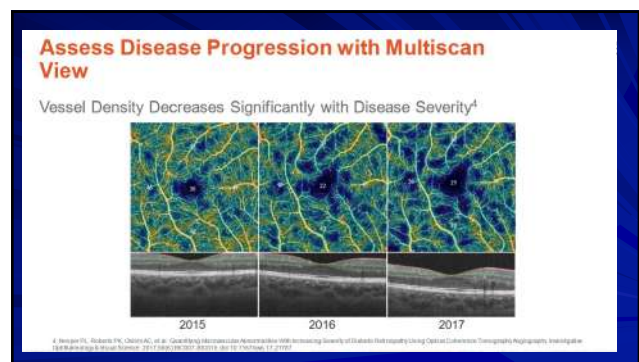
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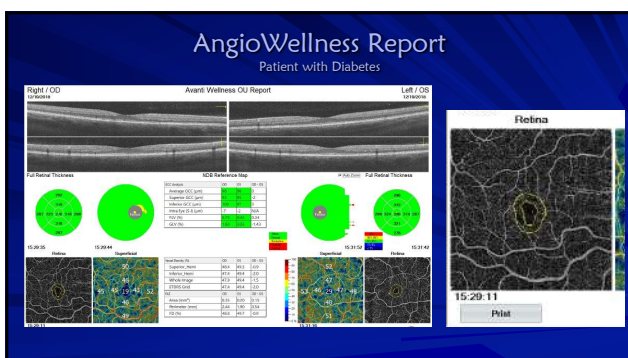
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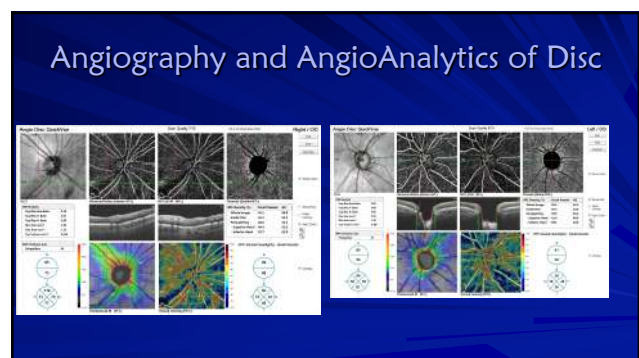
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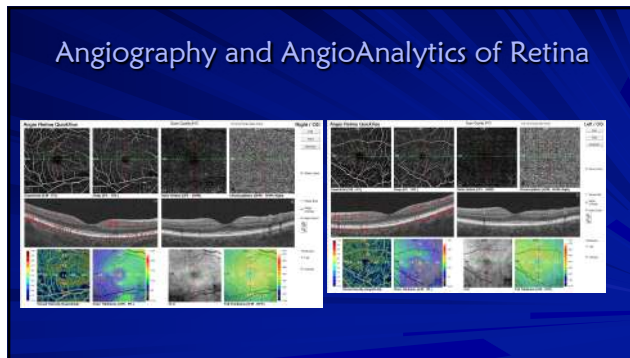
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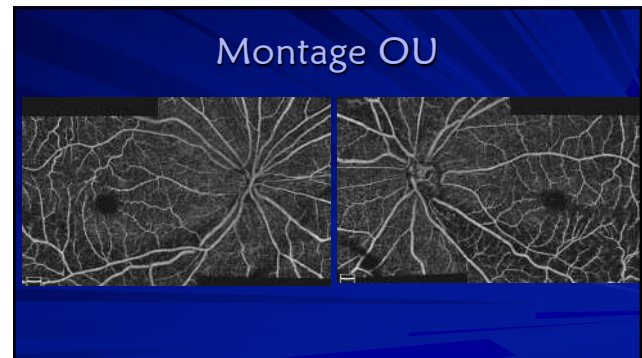
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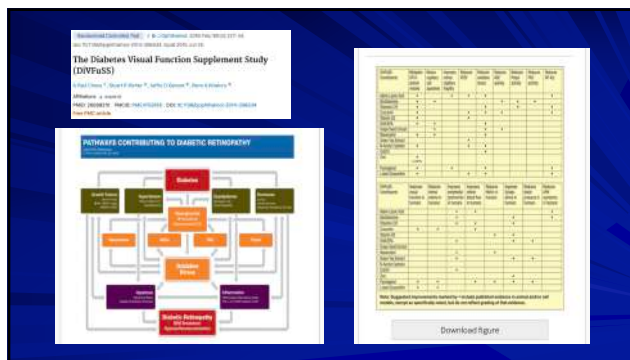
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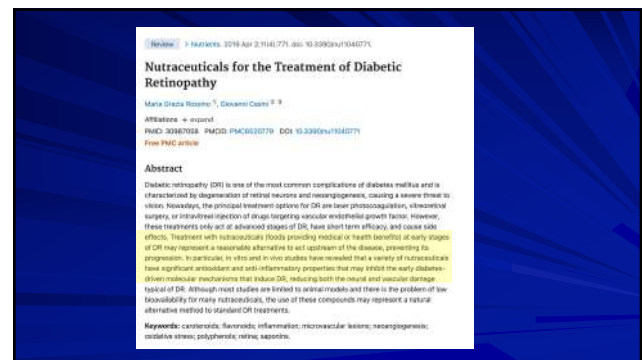
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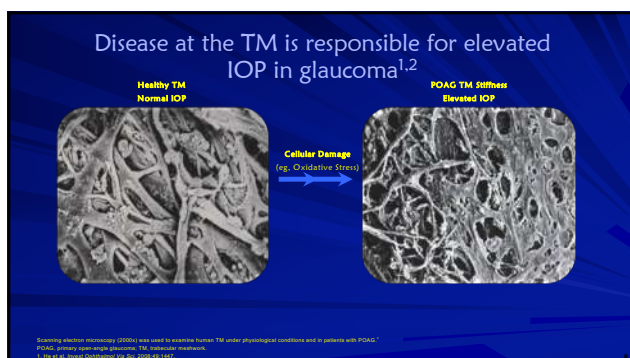
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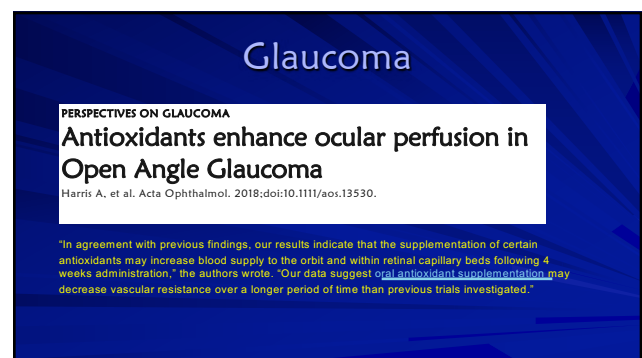
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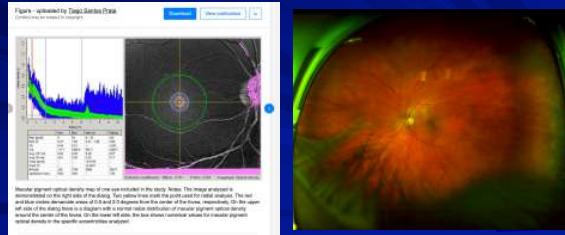


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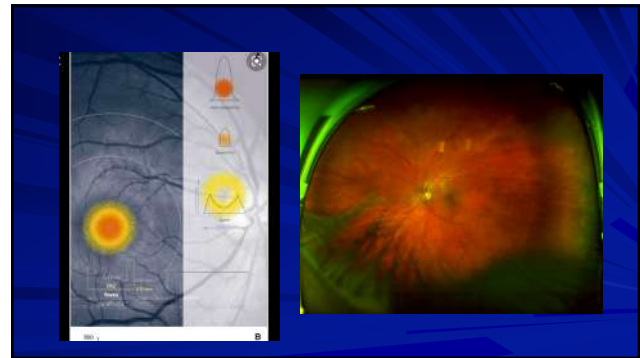




## Macular Pigment and the Retina

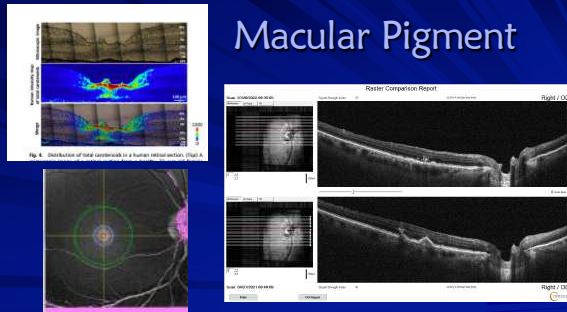


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## Macular Pigment



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## Question

Do you recommend resveratrol and quercetin antioxidants when treating ocular/retinal conditions?

- ★ Yes
- ★ No

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# Why Are We Only Treating Half the Retina?



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## Carotenoids and Polyphenols



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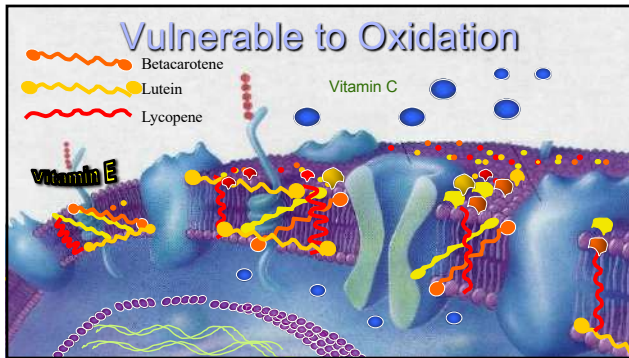
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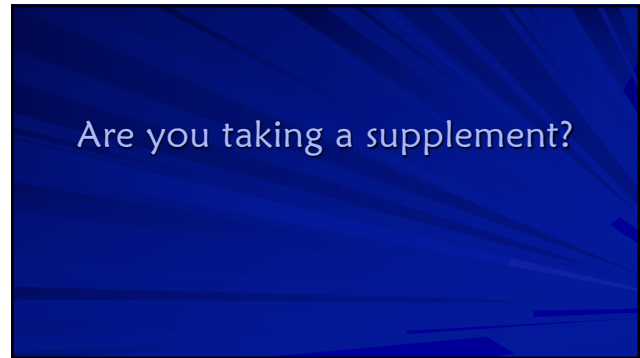
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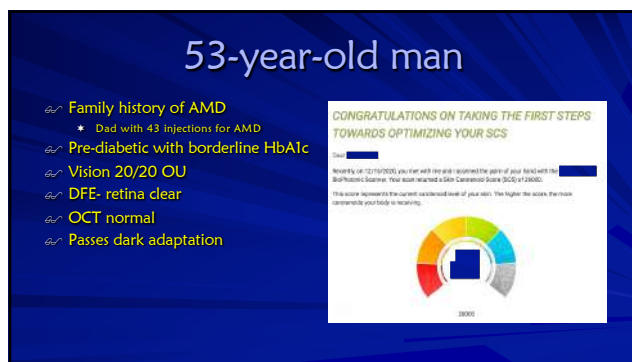




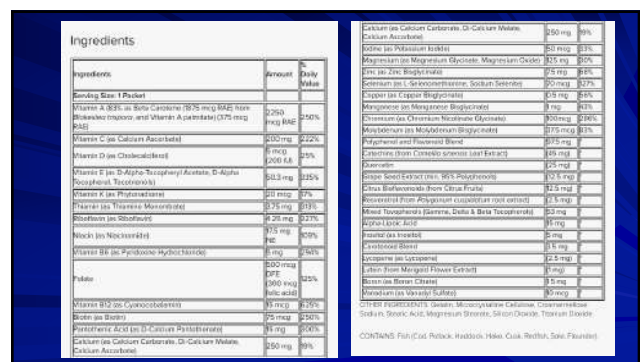
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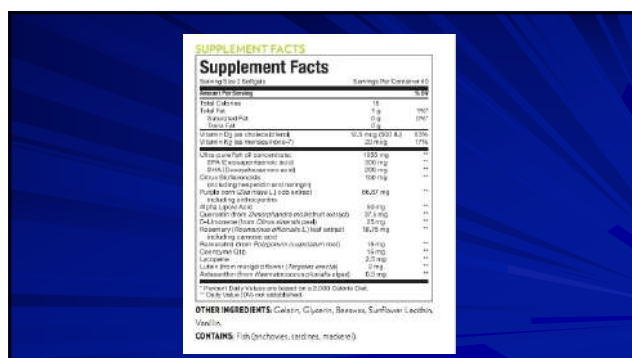
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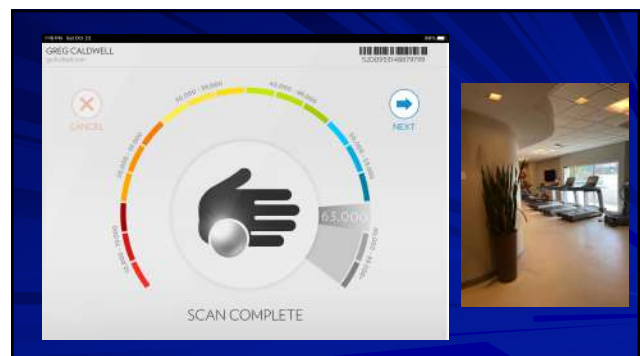
# Treat and Extend!



# Screen Everyone



- Plenty of evidence that carotenoids are beneficial in ocular and systemic prevention
- Patients are looking for guidance
  - ★ Many are on supplements
    - Surprised what they are doing is minimally helping
- Measuring ensures the patient
- Antioxidants in the eye and body go beyond lutein and zeaxanthin
- Dr. Oz "Ultimate nutritional lie detector"
- Best benefit of all...



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## Thank You for This Opportunity

☞ Do it for:

- ★ Yourself
- ★ Your family
- ★ Your staff
- ★ Your patients



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## Questions

Thank you!

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