DISCLOSURE

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- President, Carlton & Associates, LLC – Carlton and Associates, LLC provides communications and educational materials for the optical industry.
- Contributing Editor for Refractive Eyecare magazine and freelance writer to the industry.
- Communications Committee member OWA.
- Has worked in the optical industry for more than 25 years with more than half of this time spent managing practices.
- Vision Monday’s Most Influential Women Award in Optical 2005

The Science and Technology of Prescribing Photochromics

Jenean Carlton BA, ABOC, NCLC

Course #214
Monterey Symposium

PHOTOCHROMICS ARE BENEFICIAL TO PATIENTS BECAUSE THEY:
- Protect patients from harmful UV (cataracts, aging around eyes, pterygium …)
- Provide glare protection – especially important for patients with glare issues or photophobia
- Are convenient – easier than keeping up with two or more pairs of glasses
- Are variable – they automatically adjust to light conditions in the environment

LACK OF AWARENESS

- Only 9% of Americans know UV can cause eye damage

<table>
<thead>
<tr>
<th>Proportion</th>
<th>Awareness/Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 out of 4</td>
<td>Do not know there’s a treatment for glaucoma</td>
</tr>
<tr>
<td>1 out of 3</td>
<td>Do not know there’s a treatment for glaucoma</td>
</tr>
<tr>
<td>2 out of 3</td>
<td>Do not know there’s a treatment for presbyopia</td>
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HIGHER PREVALENCE OF VISION ISSUES

<table>
<thead>
<tr>
<th>Issue</th>
<th>Men Experiencing</th>
<th>Women Experiencing</th>
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</thead>
<tbody>
<tr>
<td>Dry eye</td>
<td>9%</td>
<td>15%</td>
</tr>
<tr>
<td>Trouble seeing at night</td>
<td>11%</td>
<td>22%</td>
</tr>
<tr>
<td>Light sensitivity</td>
<td>6%</td>
<td>11%</td>
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- More women say headaches impact vision, and are caused by glare
- All issues increased with age

EYE DISEASES ON THE RISE

- Americans at risk increasing as baby-boomers age
- 4 leading causes of blindness
  - Age-related macular degeneration
  - Glaucoma
  - Cataract
  - Diabetic retinopathy
- Total annual cost of adult eye diseases = $35.4 billion
- Can be detected / treated through regular eye care
THE AGING EYE

- Visual Acuity & Color Vision
  - Trouble seeing up close (presbyopia)
  - Lens yellows leading to cataracts
  - Colors less bright – reduced contrast

- Sensitivity to Light/Glare
  - Pupil shrinks = need more light
  - Causes light sensitivity

- Tear production slows
  - 30% of those age 50+ have dry eye
  - Light/Glare sensitivity worse with dry eyes

PHOTOCHROMICS ARE IMPORTANT FOR YOUR PRACTICE BECAUSE:

- Are fashionable and speak to patients interested in fashion-forward items...

- Latest and greatest regarding lens technology...

- A product that benefits every age patient...

- State of the art lenses perform better than older models and have a life span of two years or longer...

WHY ARE PHOTOCHROMICS IMPORTANT TO YOUR PRACTICE?

2010 Sunwear Sales
- 98.3 million pairs of plano sunglasses sold
- Value of 3.42 Billion

- Bring much needed revenue to your bottom line profits
- Approximately 40% of your patients come to your office interested in purchasing photochromics

IMPORANCE OF VISION WEAR

- Latest technology can do more than correct vision

  - Enhance vision for real world applications
  - Lens treatments like photochromics and anti-reflective coatings minimize glare and reflections
  - Reduce eyestrain and fatigue

- Protect eyes against trauma
  - Impact-resistant lenses, safety frames

- Preserve vision for a lifetime of healthy sight

  - Photochromic lenses block UV
  - Understanding the science of these lenses will aid you in making better lens choices for your patients

BRIEF HISTORY OF PHOTOCHROMICS

1966 - Corning introduces Photogray glass lenses with silver halide. (Silver halide is an inorganic material.)


1981 - American Optical debuts Photolite – the first plastic photochromic lens. Photolite has a trendy dark blue color, no sun protection.

1990 - PPG and Essilor International establish a joint venture called Transitions Optical, Inc. Transitions® plastic photochromic lenses introduced the same year.

1992 - Transitions Plus lenses introduced to the market

1997 - Transitions III lenses released, first Transitions lenses in polycarbonate made using Trans-bonding.

2002 - Next Generation Transitions lenses released

- Corning, Rodenstock, Signet Armorlite, other manufacturers create their own proprietary photochromic lenses soon after

2008 - Transitions VI lenses released - BIG differences

2009 - Expanded line of Transitions performance sunwear, was SOLFX now...

2010 - Transitions® XTRAActive™ lenses released

2012 - Transitions® Vantage™ lenses released! The first photochromic + variable polarization
**TERMS WE NEED TO KNOW**

- **Organic** – natural, composed of carbon or hydrogen materials
- **Inorganic** – artificial, not composed of carbon or hydrogen
- **Electromagnetic Spectrum** – an orderly arrangement of all known radiant energy
- **Silver Halide** – an inorganic material used in glass photochromics
- **Activation time** – the time it takes for a lens to darken to its full depth of color

**TERMS WE NEED TO KNOW**

- **Neutral Dyes** – desirable, result in best color perception for the wearer, esp grey
- **Fade time** – the amount of time it takes for an activated photochromic lens to revert to its clear state
- **Fatigue rate** – measurement of the lifetime of photochromic compounds, dependent on...
- **Leuco state** – when a photochromic lens has faded back to its clear form
- **Matrix** – the lens material in which photochromic dyes are incorporated - the monomer.

**How Photochromics Work..........**

**ULTRAVIOLET- THE GOOD, BAD AND UGLY**

**Beneficial uses:**
- Curing coatings on ophthalmic lenses
- Drying inks in printing processes
- Fluorescent lighting
- Sterilization of surfaces

**Bad and Just Plain Ugly:**
- Cornea, lens and retina problems
- Photokeratitis
- Skin damage and cancer

**HOW PHOTOCHROMICS WORK......**

When activated by UV light, dye molecules change their shape – as a result of this the lens changes from a leuco (clear) to a colored state. Photochromism is a reversible change of color upon exposure to UV.
Photochromic reaction
The dye crystals change shape in the presence of UV and then revert back to their original shape when UV source is removed.

Dye Performance Goals
1) Neutral, predictable and consistent color in the activated states (photochromic dyes are VERY unstable)
2) Clear in their inactivated state, unless...
3) Good activation and fade rates...
4) Fatigue resistance - what does the term “fatigue” mean?
5) Good performance even in high temperatures.

Photochromic performance is influenced by temperature, UV exposure and lens material.

Photochromic Challenges
✓ Photochromic properties fatigue after a few years, resin lenses fatigue.....
✓ Won’t activate to a dark level like sunglasses inside an auto because...
✓ Some do activate (reportedly) to a slight degree by visible light ...
✓ Temperature problems are historic for resin lenses but the new dyes are better...

Fluctuating UV Index
UV intensity fluctuates greatly depending on:
- Season (winter, summer, etc.)
- Time of day
- Latitude (north to south in relation to the equator)
- Altitude (height or elevation- ex. Mt. Everest)
- Weather conditions (cloud coverage)
- Temperature – the dyes always get darker and switch faster in colder climates.

Photochromic Dyes for Resin Lenses
Most commonly used dyes today are:
✓ Oxazine – offer fast activation and fade rates, resist photodegradation, and have a longer life span but are temperature sensitive and don’t perform well in warm climates.
✓ Naphthopyrans – stable, less temperature resistant dyes.
✓ Indenonaphthopyrans
Photochromic Dyes

C.I.E.L.A.B. is an acronym for Commission Internationale de l’Eclairage. Lightness axis, A axis, B axis

A axis measures green to red coordinates, B axis measures blue to yellow. Lower values indicate neutral colors while higher values indicate more intense colors.

Photochromic Dyes

C.I.E.L.A.B. - Stable colors result in a small ring opening.

Dye Applications

For ophthalmic lenses there are currently 5 dye application methods:

- Imbibing – Transitions Optical Inc.
- In-Mass or En-Mass – Rodenstock “ColorMatic Extra, Corning “SunSensors”
- Trans-Bonding – Transitions Optical Inc.
- Coating – Beloptix, Inc, OptiSource International

Dye Applications -- In Mass

Dyes are blended throughout the resin before the lenses are cast.

Dyes are uniformly mixed with the monomer.

Dye Applications

Image source: http://www.essilormanufacturing.in.th/index.php?cat=essilor-anthology&Id=501374&Ntype=7
Imbibed and In-Mass Technologies

DYES ARE ONLY HALF THE STORY

- Lens material used is of utmost importance...
- We know photochromic dyes don’t work well in higher index lenses but they also don’t work well in common monomers...
- Proprietary monomers are used that are compatible with the dyes... CR-307
- Other resins used...

Matrix/Composite Lens

Signet Armorlite KODAK InstaShades

- Methacrylate polymer w/photochromic dyes on front surface-
- Resin monomer on rear surface
- Both layers thermally cured together.

TRANS-BONDING

- Higher index materials like polycarbonate and 1.67 indexes are a poor host for photochromic dyes....
- Transitions Optical developed their Trans-Bonding process to offer photochromic technology in higher index lenses.

TRANS-BONDING

- Proprietary surface treatments and a series of ophthalmic grade layers provide adhesion, scratch resistance and optical purity
  1. Substrate
  2. Photochromic coating added to the substrate
  3. Protective coating and SRC added over the photochromic layer

SPECIALTY PHOTOCHROMICS

- Dinamica lenses offer lots of colors...
- X-Cel Optical- occupational segs available
- ProFit Optix
- KBco Light & Day
- Three Peaks™
- Serengeti’s Polar PhD™
- Transitions Vantage, not a traditional polarizer instead....

Substrate
Photochromic coating added to the substrate
Protective coating and SRC added over the photochromic layer
Superior abrasion resistance…
Silver halide fatigues much slower than organic dyes for resin lenses…….
Coming: PhotoGray® Thin and Dark®, PhotoBrown Extra®, PhotoGray Extra
Pros: Life span, scratch resistance.…
Cons: Heavy, safety issues, frame limitations, “raccoon effect”, manufacturing issues..

Transitions Performance Sunwear – Dynamic sunwear offering photochromic + polarized film (in some cases)
They differ from other Transitions lenses because they have an initial or “fixed” tint for glare protection in low-sunlight situations
Designed to provide wearers a visual advantage during specific outdoor activities by adjusting to changing light conditions….
So many branded sunwear products now available…..Nike, Callaway, Drivewear….

Available in grey, slight tint indoors
Availability as of May 2012: SV and PAL’s, 1.50, poly, Trivex, 1.67
Go to TransitionsVantage.com to sign up for materials…
Candidates are everyday Rx patients…
Except when patients need a constant polarizer like…
Variable polarization means…
Work together to cut glare, deliver the clearest, most adaptable vision
Deliver a double dose of what eyes need most: comfort, convenience and improved quality of vision.
Glare caused by ocular diseases: corneal edema, cataract, post-cataract, macular edema, surface irregularities.
**Photochromic Benefits Explained**

- **UV protection**: UV rays can harm the eye
- **Convenience**: Automatic amount of tint, appropriate for condition
- **Comfort**: Decreases eyestrain

**AR Benefits Explained**

- **Safety**: Glare doesn’t compromise vision
- **Health**: Less reflections, more natural vision
- **Comfort**: Eases eyestrain

**Age-Related Macular Degeneration**

- Affects 1.6 million Americans over age 60
  - 2% risk in middle age
  - Risk jumps to 30% after age 75
- Leading cause of blindness in America
- Slowly destroys clear, sharp central vision
- Cumulative UV exposure key factor
- Treatment but no cure

**Cataract**

- Affects nearly 20.5 million Americans age 65+
- Clouding of the eye’s lens (usually slow development)
- Can cause:
  - Blurred / hazy vision
  - Trouble w/ color recognition
  - Sensitivity to glare
  - Difficulty seeing at night
- Cumulative UV exposure key factor
- Treated with surgery

**Need for Vision Protection**

- **Photochromics or sunglasses to block damaging UV**
  - Short-term exposure
  - Sunburn of eye (temporary blindness)
  - Cumulative exposure
    - Cataract
    - Macular Degeneration
    - Skin cancer around eyes
  - Impact-resistant lens materials to prevent trauma

**Need for Vision Enhancement**

- Photochromics to minimize glare
  - Adapt level of darkness to let in just right amount of light
  - Reduce light sensitivity
  - Reduce eyestrain/fatigue, headaches
  - Help with color recognition
- Anti-reflective coatings to reduce reflections, enhance night driving
**GLAUCOMA**

- Affects 10% of population by age 80
- 5X more common for African-Americans
- Increasing due to growth in at-risk groups (but only 1/2 know they have it)
- Internal pressure in eye damages optic nerve, causes peripheral vision loss
- Often develops gradually, without symptoms
- Can be controlled, although vision loss permanent
- Meds can cause light sensitivity
- 1/2 don’t know they have it

**PHOTO CREDIT:** www.aoa.org

**DIABETES AND EYE DISEASE**

**Diabetes can lead to several eye diseases**

*Diabetic Retinopathy* = most common diabetes-related eye disease

<table>
<thead>
<tr>
<th>Percent of Consumers Ever Experiencing the Following Eye Diseases</th>
<th>Diabetics</th>
<th>Non Diabetics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cataracts</td>
<td>10%</td>
<td>4%</td>
</tr>
<tr>
<td>Diabetic Retinopathy</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Macular Degeneration</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Glaucoma</td>
<td>10%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*Transitions Optical Global Healthy Sight Survey, 2008*

**VISION WEAR NEEDS OF DIABETICS**

Diabetes and related diseases pose danger for vision in future

- Increased susceptibility to UV damage
- Light sensitivity
- Poor contrast sensitivity, night vision
- UV and glare protection
  - Fixed tint and photochromic lenses
  - AR treatments

**VISION WEAR NEEDS OF THOSE WITH HYPERTENSION**

- Some medications for hypertension can cause light sensitivity
- Photochromics can alleviate discomfort

**EYE CARE / EYEWARE IMPORTANT FOR MENTAL HEALTH**

- Vision wear for prevention and treatment
  - Corrected vision associated with fewer problems, enhanced mood
  - Glare protection (photochromics/AR) to enhance contrast, address light sensitivity from meds
  - UV blockage to prevent damage

**PHOTO CREDIT:** NIH National Eye Institute

Damage to vision will have already occurred in 5% of diabetics diagnosed at age 30+

*— Diabet Manh, 2004*
Older adults take more medications. Up to 90% take Rx, OTC, or supplements. 1/4 don’t usually tell their eye doctor. 2/3 of older adults are unaware of side effects on eyes.

Medications can cause:
- Blurry vision
- Sensitivity to light/glare
- Susceptibility to UV damage
- Increase in certain eye diseases
- E.g. Steroids/inhalers can lead to cataract, glaucoma

Some effects can be alleviated through proper vision wear.

Older adults taking antidepressants have higher risk for cataract. Journal of AAO

Breast Cancer – Top Fatal
- Bleeding, Cataract, Dry and light sensitivity
- Medication use: blurred vision, UV light sensitivity, dry eye
- Pregnancy: Rx changes
- Menopause: Rx changes, dry eye
- Auto-Immune Diseases
  - Sjogrens – Lupus
  - Rheumatoid arthritis
  - UVIglare-protecting vision wear recommended

Hand Off in exam room is ideal.

Opticians reinforce the recommendations.

Multiple times the patient hears the Rx.

Make use of try-on sample lenses.

Offer a lens menu describing features of advanced offerings.

INTEGRATING PHOTOCROMICS TO YOUR PRACTICE

Stay on top of the latest in cutting-edge lens technology and designs by:
- Utilizing your lab staff for training...
- Attending courses...
- Reading periodicals... VCPN, Eyecare Business, etc.

Incorporating a lifestyle discussion/program in your practice.
- Doctor – Driven - Dispensing

Discuss the benefits of photochromics during the exam.
- Medical benefits of photochromics

Include a listing of all lens options on your Rx.
- And if possible – the benefit of the option.

Explain Features and Benefits to patients.
- Forget “Techno-babble”
- What if all lens options were FREE?

<table>
<thead>
<tr>
<th>Features</th>
<th>Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorbs UV</td>
<td>Protection for eyes</td>
</tr>
<tr>
<td>Variable tint</td>
<td>Adapts to light conditions, comfort</td>
</tr>
<tr>
<td>Specialty options for sports</td>
<td>Enhance performance</td>
</tr>
<tr>
<td>Convenience</td>
<td>Easier than carrying multiple pairs of eyewear</td>
</tr>
</tbody>
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**PRESENTING PHOTOCHROMICS**

- “How do you use your eyes?”
- “How do you protect your eyes from glare and UV?”
- “Let me tell you about what I wear to protect my eyes.”
- Language to use when discussing photochromics.

**SUMMARY**

- Photochromics protect patients from harmful UV and glare...
- Photochromics + polarized are now available with either a constant polarizer layer or as a variable polarized lens (Transitions Vantage)
- Doctor driven dispensing has proved to be successful...
- Patients want to know about features and benefits...
- Are convenient and cost effective...

**RAPID REVIEW**

- Discuss why photochromic lenses won’t darken in an automobile.
- Does AR affect the performance of photochromic lenses?
- Discuss how photochromics + polarized benefit patients.

**THANK YOU!!**

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