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New York State Continuing Education Mail-In Course

Rigid Gas Permeable Extended Wear

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With the advent of a new generation of super and hyper permeable RGP materials, RGP extended wear has become a reality. Why should manufacturers continue to develop better extended wear materials and why should fitters consider extended wear as a potential modality? Some patients still find lens care and insertion and removal of contact lenses an inconvenience. The eyeglass industry has done an excellent job of improving and merchandizing their product as a fashion device. The refractive surgery proponents have an elaborate advertising machine. The contact lens industry must continue to develop better materials and fitting techniques if we want to grow and flourish.

Patient Selection

Because there is increased risks for adverse reaction with extended wear the patient and the fitter must both be aware of these risk factors. It is important to do a proper patient interview. If a patient is interested in extended wear, find out what their expectations of extended wear are going to be. Some people may have unreasonable expectations of what extended wear is. It is important to have a compliant patient. The patient must be willing to come in to be examined if complications develop. Patients who have previously been successful daily wear RGP lens wearers have proven to be good extended wear candidates.

History

It is critical to do a complete history when fitting a potential extended wear candidate. It is important to find out about the following:

- Allergies
- Respiratory ailments
- Medications
- Systemic conditions (diabetics, etc.)

- Previous lens wear
- Previous lens complications
- Occupations
- Overall health
- Smoker

People with chronic allergies or sinus problems would be poor candidates for extended wear. People with very mild seasonal allergies may have to revert back to daily wear when their allergies are active. Some medications such as diuretics, allergy, cold and sinus medication can have an adverse affect on the tear film making extended wear or contact lens wear in general difficult. Certain systemic conditions such as diabetics would be poor extended wear candidates. Diabetics are more prone to adverse corneal response from contact lenses and have much slower healing process when corneal problems develop.

Previous lens wear and lens wear complications are important to review. People with a previous history of GPC, blepharitis and chalazions may likely have recurrences with extended wear.

Complications

It is critical to recognize the subjective symptoms and the objective signs of RGP extended wear complications. The rest this article will discuss the complications related to RGP extended wear, which are similar to the complications of daily wear RGP lens wear, except they may occur at an accelerated rate.¹ Since complications may occur at an accelerated rate it is important to have a good schedule to follow to track your extended wear patients properly. Com-

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plications can be split into two categories:

- Material Related¹
- Fitting Technique¹

Material Related Complications

Hypoxia can be a problem of extended wear, so it is important that we discuss the oxygen requirements of the cornea. Holden and Mertz performed the key study showing the oxygen transmissibility values to maintain good corneal health. They found that for daily wear with no corneal edema the lenses needed an oxygen transmissibility of at least 24.1×10^{-9} or an equivalent oxygen percentage (EOP) of 9.9%. The minimum for extended wear is an EOP of 12.1% or a DK/L average of 34.3×10^{-9} . This minimum would allow the cornea approximately 8% overnight swelling, but the cornea would be able to rebound to an edema free state shortly after awakening.

To achieve 4% overnight corneal swelling (the level that occurs when no lens is worn) the EOP needs to be 17.9% or a DK/L of 87.0×10^{-9} . There are RGP lens materials that approach or exceed these standards set by Holden and Mertz. The additional benefits of smaller lens diameters and increased tear exchange of rigid lenses makes them better suited to extended wear, than soft lenses.

The average overnight swelling for non-lens wearing cornea is 4%. But the range is from 2% to 10% depending on the individual.¹ People on the high end of normal corneal swelling will be less successful with extended wear than people on the low end of normal corneal swelling.¹ That may be why two people wearing the same extended wear lens may not have the same results. Therefore it is critical to have a good follow up regimen for our extended wear patients combined with good clinical skills with your slit lamps and good listening skills.

Epithelial Microcysts

Microcysts are small refractile lesions, irregular in shape and can vary in size.¹ They show reversed illumination under high magnification. Studies show that microcysts are pockets of dead and/or malformed cells, which originate at the basement membrane and progress to the surface of the epithelium.¹ Microcysts are believed to be caused by hypoxia as they are rarely seen in the absence of hypoxia. Microcysts are not immediately apparent after the creation of the hypoxic environment. They also take a while to progress through the epithelium even if the hypoxic environment is eliminated. Microcysts will cause staining after they have broken through the surface. Microcysts are best viewed through marginal retro-illumination near the inferior pupil border.^{1,4} Microcysts, because they are refractile lesions are not visible in direct illumination.

It is best to use a grading scale to rate the severity of the microcysts. Usually they are graded on the amount of microcysts present.

Striae and Folds

Striae or folds are signs of corneal swelling due to edema. Striae are fine, vertical grayish-white lines in the posterior

stroma.¹ They are thought to be caused by fluid separation of collagen fibrils.¹ They are thought to appear when the level of corneal edema reaches 5 or 6%.

When edema levels reach above 10%, stromal folds may appear.¹ These appear as dark lines in the posterior stroma and represent buckling of the posterior corneal layer.¹ If folds are evident, extended wear should be discontinued. Striae may be visible after awakening but should disappear within a couple of hours of awakening. If the striae don't disappear within that time, the cornea may not be able to rebound from the levels of edema that occur during sleep. It is important to perform your contact lens checks during different times during the day.

It is important to listen to our patients' symptoms since, they often at times, can tell us what to look for. Patients who have hazy or foggy vision, which doesn't clear within 15 to 20 minutes, may be having persistent edema, even though they may not show clinical signs by the time you see them in the office.

Polymegathism

Polymegathism is the change in size of the endothelial cells as caused by hypoxia. The change in cell shape as caused by hypoxia is called pleomorphism. Super and hyper DKRGP materials have much less affect on polymegathism than PMMA or previous generations of low DK materials.

Giant Papillary Conjunctivitis (GPC)

Papillary changes to the upper tarsal plate are seen infrequently with RGP lenses than with soft lenses, but they can occur. Proper cleaning and the use of liquid enzymes can help keep the lens surfaces clean and prevent papillary changes. An early sign of papillary changes are hyperemia to the upper tarsal plate, which may be a precursor to GPC.

Ptosis

It has been reported, by Fonn and Holden, of upper lid ptosis in patients wearing RGP lenses. This author has seen it in daily and extended wear RGP lens wearers. The ptosis is alleviated with the discontinuation of lens wear. It is believed to be edema to the upper lid in response to the trauma of a rigid lens.¹

Fit and Lens Design Related Complications

Peripheral Corneal Desiccation

(3 & 9 staining)

The main staining problem with RGP lenses whether daily or extended wear is 3 and 9 o'clock staining. It is important to grade the level of GPC on a scale of 0 to 4 while the patient is wearing their lenses on a daily wear basis.

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There are a couple of manufacturers who have grading charts available so you can be consistent in your grading. Having 3 & 9 o'clock staining grade 2 or higher would be a contra-indication to extended wear. What may be a mild condition can be more severe with extended wear. Perform your pre-fitting exam and follow up check ups while the patient is in the daily wear mode. Schnider and Terry¹ have done studies that have indicated that patients that have higher baseline conjunctival hyperemia (redness) are more prone to significant 3 & 9 staining.¹ Also, patients with more tear film lipids and debris, faster lens drying times and poor lens centration and movement were more likely to have significant 3 & 9 corneal desiccation.¹ Their study found that edge clearance was the key lens design factor in minimizing staining. More staining was found when the edge clearance was too shallow or too narrow.¹

One of the things that can be done to the contact lens to minimize 3 & 9 staining, is to make sure the peripheral curves are well blended.¹ This makes it easier for the tears to exchange under the lens. You can check the blends with fluorescent tube reflection method. Widening or flattening the peripheral curve system may also help provide an adequate peripheral tear film reservoir.¹ This will allow better lens translation¹ and tear distribution over the flatter peripheral areas of the cornea. The third thing that can be done is to taper the anterior edge if the edge is too thick. If the edge is too thick this may create a lid gap which prevents the lids from spreading the tears across the peripheral cornea.

Conjunctival Staining

Conjunctival staining with fluorescein or rose bengal dye can also occur with lenses that don't position properly. If a lens positions excessively high, you may see an arcuate band of staining on the inferior conjunctiva with rose bengal dye.¹ Also if a lens rides excessively low you may see rose bengal staining in an arcuate pattern adjacent to the lens.¹

Lens Binding

Lens binding is a complication of RGP extended wear that can be difficult to correct. Lens binding is also a complication with daily wear RGP lens wear. Most RGP extended wear patients will have lens binding at least occasionally upon awakening. The lens should become mobile within a few minutes after awakening. If the lens binding persists, significant complications can develop. Patients can be trained to check for lens movement in a mirror with a penlight in the morning. Symptoms of lens binding are:

- Good comfort for 3 or 4 hours followed by dryness or grittiness
- Blurry vision
- Spectacle blur after lens removal
- Difficulty with lens removal

Objective signs of lens binding are:

- Trapped debris or mucous under non moving lens

Other objective signs may also be evident even if the lens is mobile when the patient is in the office for a contact lens check up. These signs are:

- Central punctate staining

- Corneal indentation ring after lens removal
- Arcuate area of negative staining in the area of the peripheral curves
- Arcuate area of corneal staining adjacent to the lens edge, when no staining was noticed in this area on previous check ups
- Corneal distortion

Swarbrick and colleagues have done studies on this lens-binding phenomenon and have found that the lenses seem to bind in a decentered position, most often superior or nasal.^{1,5} Swarbrick challenged this theory by fenestrating a lens on a patient who had shown frequent lens binding.⁵ Even after fenestration, lens binding continued. Swarbrick proposes that a loss of aqueous causes an increase in viscosity of the post-lens tear film.¹ This increase in viscosity of the tear film creates an increase in the resistance to lens movement.¹ Adhesive forces will be greater with larger diameters and smaller edge clearances. Lens design changes that may help when lens binding occurs are:

- Reduce lens diameter if a large diameter is being used (8.8mm to 9.2mm)¹
- Fit with minimal apical clearance with moderate blending of the transitional zone¹
- Use wide and moderately flat peripheral tear reservoirs¹

Sometimes deposits on the posterior surface of the lens may accelerate lens binding.⁶ These deposits can be hard to see sometimes. Using the radiuscope can assist you in seeing these deposits.

Contact Lens Follow Up Exam For Extended Wear

A careful case history should begin the contact lens follow up exam for extended wear. The history should include a review of the

- Extended wear wearing schedule
- Fogging or blurring of vision upon awakening
- Make sure patient is doing morning self-assessment test for lens movement
- Comfort or discomfort
- Patients perception of visual acuity
- Glare
- Spectacle blur

Following the history a visual acuity and over-refraction should be performed. Keratometry over the contact lens may also be performed if lens flexure is suspected.

Biomechanics first with white light then with fluorescein should be performed next with the lenses in place. Things to look for during the biomicroscope exam are

- Surface wetting
- Surface deposits
- Trapped surface debris
- Punctate staining under the lens (may be sign of lens binding)
- Peripheral corneal staining (3 % 9)

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- Peripheral corneal staining should be graded on a scale of 0 to 4
- Peripheral arcuate stain when none was previously noted (may be a sign of lens binding)
- Microcysts

After the lenses are removed another biomicroscope exam should be performed checking the corneal and conjunctival surfaces closely. Any surface irritation noted with the lenses on should be scrutinized with the lenses off. The cornea should also be inspected for microcysts.

Following the biomicroscope exam without lenses on, keratometry and a refraction should be performed. Expect to find some corneal flattening and a "sphericalization" on toric corneas.¹ While you may find less myopia in the refraction you should not find a reduction in visual acuity.

The contact lenses should then be inspected for scratches, deposits, defects and all parameters should be reverified and compared to original parameters ordered.

Patient Follow Up Protocol

Patients should first be on a daily wear schedule successfully before moving on to extended wear. After successful completion of a daily schedule the follow up schedule is as follows:

- First day after overnight wear (morning visit preferred)
- One week
- One month
- Three months
- Every six months after that

If complications develop, the follow up schedule may have to be altered to see the patient more frequently.

Lens Materials

For full time extended wear (six nights) fluoro-silicone acrylates with DK's of 90 or above should be used. The lenses should be replaced every year or at least every other year. Proper cleaning and disinfecting techniques should be used, including enzymes. The new liquid enzymes should help with compliance and seem to be effective.

Summary

RGP extended wear offers an alternative to refractive surgery and eyeglasses. It can be safe and effective when the patient and the fitter take the proper precautions and are compliant. Good patient selection and education will go a long way in having a successful extended wear selection.

References

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Rigid Gas Permeable Extended Wear Mail-In Test

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1. *Diabetics are poor candidates for extended wear because:*
 - A. Their refraction might change.
 - B. They are prone to adverse corneal responses
 - C. Their corneas are slow to heal
 - D. They have high intraocular pressure
 - E. B and C
2. *The minimum EOP for extended wear is:*
 - A. 9.9%
 - B. 12.1%
 - C. 17.9%
 - D. 4%
3. *To achieve 4% overnight corneal swelling a contact lens would have an EOP of:*
 - A. 9.9%
 - B. 12.1%
 - C. 17.9%
 - D. 10%
4. *Rigid gas permeable lenses may be better suited to extended wear than soft lenses because:*
 - A. RGP lenses allow an increased tear exchange under the lens
 - B. RGP lenses are easier to handle
 - C. RGP lenses have better vision
 - D. RGP lenses are less costly
5. *The average level of corneal swelling during sleep even if no lens is worn is:*
 - A. 9.9%
 - B. 12.1%
 - C. 17.9%
 - D. 4%
6. *Small refractile lesions seen in the cornea as a complication of extended wear are called:*
 - A. Pinguicula
 - B. Pterygium
 - C. Striae
 - D. Microcysts
7. *Microcysts are believed to be caused by:*
 - A. Solution sensitivity
 - B. Hypoxic environment
 - C. Soft lenses
 - D. PMMA lenses
8. *Microcysts are best seen under what illumination?*
 - A. Retro-illumination
 - B. Direct illumination
 - C. Tangential illumination
 - D. Sclerotic scatter
9. *Microcysts are found in the:*
 - A. Endothelium
 - B. Descemet's membrane
 - C. Epithelium
 - D. Stroma
10. *Striae or folds, found in the cornea are signs of corneal swelling due to edema.*
 - A. True
 - B. False
11. *Striae first appear in the cornea when the level of corneal edema reaches:*
 - A. 9.9%
 - B. 17.9%
 - C. 5 or 6%
 - D. 25%
12. *An extended wear patient who reports hazy or foggy vision which doesn't clear within 20 minutes after awakening may have:*
 - A. Persistent corneal edema
 - B. 3 and 9 o'clock staining
 - C. A warped lens
 - D. Vascularization
13. *Polymegathism is a:*
 - A. Change in endothelial cell shape
 - B. Change in endothelial cell size
 - C. Change in epithelial cell shape
 - D. Change in epithelial cell size
14. *A change in endothelial cell shape is called:*
 - A. Polymegathism
 - B. Pleomorphism
 - C. Squamous
 - D. Basal
15. *Hyperemia to the upper tarsal plate of the superior eyelids may be a precursor to:*
 - A. Giant papillary conjunctivitis
 - B. 3 and 9 o'clock staining
 - C. Microcystic edema
 - D. Pink eye
16. *The key lens design factor in minimizing 3 and 9 staining is:*
 - A. Base curve
 - B. Material
 - C. Peripheral edge clearance
 - D. Diameter
17. *A symptom of lens binding is:*
 - A. Central Punctate staining
 - B. Corneal indentation ring
 - C. Arcuate stain
 - D. Good comfort for 3 or 4 hours followed by dryness or grittiness
18. *Objective signs of lens binding are:*
 - A. Blurry vision
 - B. Spectacle blur after lens removal
 - C. Corneal indentation ring after lens removal
 - D. Difficulty with lens removal
19. *Fitting an RGP extended wear lens with minimal apical clearance will help alleviate:*
 - A. Lens binding
 - B. GPC
 - C. Corneal edema
 - D. Microcysts
20. *The first follow exam for a new extended wear patient would be:*
 - A. 1 week
 - B. The next morning
 - C. 3 days
 - D. 5 days

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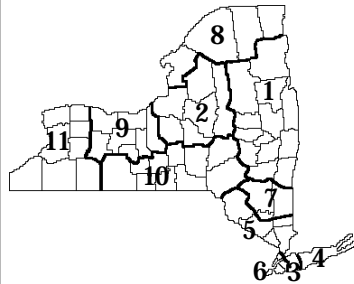
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