



## CORNEA/EXTERNAL DISEASE SUMMARY BENCHMARKS FOR PREFERRED PRACTICE PATTERN® GUIDELINES

### Introduction

These are summary benchmarks for the Academy's Preferred Practice Pattern® (PPP) guidelines. The Preferred Practice Pattern series of guidelines has been written on the basis of three principles.

- Each Preferred Practice Pattern should be clinically relevant and specific enough to provide useful information to practitioners.
- Each recommendation that is made should be given an explicit rating that shows its importance to the care process.
- Each recommendation should also be given an explicit rating that shows the strength of evidence that supports the recommendation and reflects the best evidence available.

**Preferred Practice Patterns provide guidance for the pattern of practice, not for the care of a particular individual.** While they should generally meet the needs of most patients, they cannot possibly best meet the needs of all patients. Adherence to these Preferred Practice Patterns will not ensure a successful outcome in every situation. These practice patterns should not be deemed inclusive of all proper methods of care or exclusive of other methods of care reasonably directed at obtaining the best results. It may be necessary to approach different patients' needs in different ways. The physician must make the ultimate judgment about the propriety of the care of a particular patient in light of all of the circumstances presented by that patient. The American Academy of Ophthalmology is available to assist members in resolving ethical dilemmas that arise in the course of ophthalmic practice.

**The Preferred Practice Pattern® guidelines are not medical standards to be adhered to in all individual situations.** The Academy specifically disclaims any and all liability for injury or other damages of any kind, from negligence or otherwise, for any and all claims that may arise out of the use of any recommendations or other information contained herein.

For each major disease condition, recommendations for the process of care, including the history, physical exam and ancillary tests, are summarized, along with major recommendations for the care management, follow-up, and education of the patient. For each PPP, a detailed literature search of PubMed and the

Cochrane Library for articles in the English language is conducted. The results are reviewed by an expert panel and used to prepare the recommendations, which are then given a rating that shows the strength of evidence when sufficient evidence exists.

To rate individual studies, a scale based on the Scottish Intercollegiate Guideline Network (SIGN) is used. The definitions and levels of evidence to rate individual studies are as follows:

- I++: High-quality meta-analyses, systematic reviews of randomized controlled trials (RCTs), or RCTs with a very low risk of bias
- I+: Well-conducted meta-analyses, systematic reviews of RCTs, or RCTs with a low risk of bias
- I-: Meta-analyses, systematic reviews of RCTs, or RCTs with a high risk of bias
- II++: High-quality systematic reviews of case-control or cohort studies; high-quality case-control or cohort studies with a very low risk of confounding or bias and a high probability that the relationship is causal
- II+: Well-conducted case-control or cohort studies with a low risk of confounding or bias and a moderate probability that the relationship is causal
- II-: Case-control or cohort studies with a high risk of confounding or bias and a significant risk that the relationship is not causal
- III: Nonanalytic studies (e.g., case reports, case series)

Recommendations for care are formed based on the body of the evidence. The body of evidence quality ratings are defined by Grading of Recommendations Assessment, Development and Evaluation (GRADE) as follows:

- Good quality (GQ): Further research is very unlikely to change our confidence in the estimate of effect
- Moderate quality (MQ): Further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate
- Insufficient quality (IQ): Further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate; any estimate of effect is very uncertain



## CORNEA/EXTERNAL DISEASE SUMMARY BENCHMARKS FOR PREFERRED PRACTICE PATTERN® GUIDELINES

### **Introduction** *(continued)*

Key recommendations for care are defined by GRADE as follows:

- Strong recommendation (SR): Used when the desirable effects of an intervention clearly outweigh the undesirable effects or clearly do not
- Discretionary recommendation (DR): Used when the trade-offs are less certain—either because of low-quality evidence or because evidence suggests that desirable and undesirable effects are closely balanced

In PPPs prior to 2011, the panel rated recommendations according to its importance to the care process. This “importance to the care process” rating represents care that the panel thought would improve the quality of the patient’s care in a meaningful way. The ratings of importance are divided into three levels.

- Level A, defined as most important
- Level B, defined as moderately important
- Level C, defined as relevant but not critical

The panel also rated each recommendation on the strength of evidence in the available literature to support the recommendation made. The “ratings of strength of evidence” also are divided into three levels.

- Level I includes evidence obtained from at least one properly conducted, well-designed randomized controlled trial. It could include meta-analyses of randomized controlled trials.
- Level II includes evidence obtained from the following:
  - Well-designed controlled trials without randomization
  - Well-designed cohort or case-control analytic studies, preferably from more than one center
  - Multiple-time series with or without the intervention
- Level III includes evidence obtained from one of the following:
  - Descriptive studies
  - Case reports
  - Reports of expert committees/organizations (e.g., PPP panel consensus with external peer review)

This former approach, however, will eventually be phased out as the AAO adopted the SIGN and GRADE rating and grading systems.

The PPPs are intended to serve as guides in patient care, with greatest emphasis on technical aspects. In applying this knowledge, it is essential to recognize that true medical excellence is achieved only when skills are applied in a such a manner that the patients’ needs are the foremost consideration. The AAO is available to assist members in resolving ethical dilemmas that arise in the course of practice. (AAO Code of Ethics)

## Bacterial Keratitis (Initial Evaluation)

### Initial Exam History

- Ocular symptoms (e.g., degree of pain, redness, discharge, blurred vision, photophobia, duration of symptoms, circumstances surrounding the onset of symptoms) *(III, GQ, SR)*
- Contact lens history (e.g., wearing schedule, overnight wear, type of contact lenses, contact lens solution, contact lens hygiene protocol, tap-water rinse of contact lenses, swimming, using a hot tub, or showering while wearing contact lenses) *(II+, GQ, SR)*
- Review of other ocular history, including risk factors such as herpes simplex virus keratitis, varicella zoster virus keratitis, previous bacterial keratitis, trauma, dry eye, and previous ocular surgery, including refractive surgery *(III, GQ, SR)*
- Review of other medical problems *(III, GQ, SR)*
- Current and recently used ocular medications *(III, GQ, SR)*
- Medication allergies *(III, GQ, SR)*

### Initial Physical Exam

- Visual acuity *(III, GQ, SR)*
- General appearance of patient, including skin conditions *(III, GQ, SR)*
- Facial examination *(III, GQ, SR)*
- Globe position *(III, GQ, SR)*
- Eyelids and eyelid closure *(III, GQ, SR)*
- Conjunctiva *(III, GQ, SR)*
- Nasolacrimal apparatus *(III, GQ, SR)*
- Corneal sensation *(III, GQ, SR)*
- Slit-lamp biomicroscopy *(III, GQ, SR)*
  - Eyelid margins *(III, GQ, SR)*
  - Conjunctiva *(III, GQ, SR)*
  - Sclera *(III, GQ, SR)*
  - Cornea *(III, GQ, SR)*
  - Anterior chamber for depth and the presence of inflammation, including cell and flare, hypopyon, fibrin, hyphema *(III, GQ, SR)*
  - Anterior vitreous *(III, GQ, SR)*
  - Contralateral eye for clues to etiology as well as possible similar underlying pathology *(III, GQ, SR)*

### Diagnostic Tests

- Manage majority of community-acquired cases with empiric therapy and without smears or cultures. *(III, IQ, DR)*

- Indications for smears and cultures:
  - Sight-threatening or severe keratitis of suspected microbial origin prior to initiating therapy. *(III, IQ, DR)*
  - A large central corneal infiltrate that extends to the middle to deep stroma. *(III, IQ, DR)*
  - Chronic in nature. *(III, IQ, DR)*
  - Unresponsive to broad spectrum antibiotic therapy. *(III, IQ, DR)*
  - Clinical features suggestive of fungal, amoebic, or mycobacterial keratitis. *(III, IQ, DR)*
- The hypopyon that occurs in eyes with bacterial keratitis is usually sterile, and aqueous or vitreous taps should not be performed unless there is a high suspicion of microbial endophthalmitis. *(III, IQ, DR)*
- Corneal scrapings for culture should be inoculated directly onto appropriate culture media to maximize culture yield. *(III, IQ, DR)* If this is not feasible, place specimens in transport media. *(II+, MQ, DR)* In either case, immediately incubate cultures or take promptly to the laboratory. *(III, GQ, SR)*

### Care Management

- Topical antibiotic eye drops are preferred method in most cases. *(III, GQ, SR)*
- Use topical broad-spectrum antibiotics initially in the empiric treatment of presumed bacterial keratitis. *(III, IQ, DR)*
- For central or severe keratitis (e.g., deep stromal involvement or an infiltrate larger than 2 mm with extensive suppuration), use a loading dose (e.g., every 5 to 15 minutes for the first 30 to 60 minutes), followed by frequent applications (e.g., every 30 minutes to 1 hour around the clock). *(III, IQ, DR)* For less severe keratitis, a regimen with less frequent dosing is appropriate. *(III, IQ, DR)*
- Use systemic therapy for gonococcal keratitis. *(III, IQ, DR)*
- For patients treated with ocular topical corticosteroids at time of presentation of suspected bacterial keratitis, reduce or eliminate corticosteroids until infection has been controlled. *(III, GQ, SR)*
- When the corneal infiltrate compromises the visual axis, may add topical corticosteroid therapy following at least 2 to 3 days of progressive improvement with treatment with topical antibiotics. *(III, IQ, DR)* Continue topical antibiotics at high levels with gradual tapering. *(III, IQ, DR)*
- Examine patients within 1 to 2 days after initiation of topical corticosteroid therapy. *(III, IQ, DR)*

## Bacterial Keratitis (Management Recommendations)

### Patient Education

- Inform patients with risk factors predisposing them to bacterial keratitis of their relative risk, the signs and symptoms of infection, and to consult an ophthalmologist promptly if they experience such warning signs or symptoms (*III, GQ, SR*)
- Educate about the destructive nature of bacterial keratitis and need for strict compliance with therapy (*III, GQ, SR*)
- Discuss possibility of permanent visual loss and need for future visual rehabilitation (*III, GQ, SR*)
- Educate patients with contact lenses about increased risk of infection associated with contact lens, overnight wear, and importance of adherence to techniques to promote contact lens hygiene (*III, GQ, SR*)
- Refer patients with significant visual impairment or blindness for vision rehabilitation if they are not surgical candidates (see [www.aaopt.org/smart-sight-low-vision](http://www.aaopt.org/smart-sight-low-vision))

### Antibiotic Therapy of Bacterial Keratitis

Organism	Topical Antibiotic	Subconjunctival Concentration	Dose
No organism identified or multiple types of organisms	Cefazolin	50 mg/ml	100 mg in 0.5 ml
	with Tobramycin or gentamicin or Fluoroquinolones*	9–14 mg/ml	20 mg in 0.5 ml
		Various†	
Gram-positive Cocci	Cefazolin	50 mg/ml	100 mg in 0.5 ml
	Vancomycin‡	15–50 mg/ml	25 mg in 0.5 ml
	Bacitracin‡	10,000 IU	
	Fluoroquinolones*	Various†	
Gram-negative Rods	Tobramycin or gentamicin	9–14 mg/ml	20 mg in 0.5 ml
	Ceftazidime	50 mg/ml	100 mg in 0.5 ml
	Fluoroquinolones	Various†	
Gram-negative Cocci§	Ceftriaxone	50 mg/ml	100 mg in 0.5 ml
	Ceftazidime	50 mg/ml	100 mg in 0.5 ml
	Fluoroquinolones	Various†	
Nontuberculous Mycobacteria	Amikacin	20–40 mg/ml	20 mg in 0.5 ml
	Clarithromycin	10 mg/ml	
	Azithromycin//	10 mg/ml	
	Fluoroquinolones	Various†	
Nocardia	Sulfacetamide	100 mg/ml	
	Amikacin	20–40 mg/ml	20 mg in 0.5 ml
	Trimethoprim/ Sulfamethoxazole:		
	Trimethoprim	16 mg/ml	
	Sulfamethoxazole	80mg/ml	

\* Fewer gram-positive cocci are resistant to gatifloxacin and moxifloxacin than other fluoroquinolones.

† Besifloxacin 6mg/ml; ciprofloxacin 3 mg/ml; gatifloxacin 3 mg/ml; levofloxacin 15 mg/ml; moxifloxacin 5 mg/ml; ofloxacin 3 mg/ml, all commercially available at these concentrations

‡ For resistant *Enterococcus* and *Staphylococcus* species and penicillin allergy. Vancomycin and bacitracin have no gram-negative activity and should not be used as a single agent in empirically treating bacterial keratitis.

§ Systemic therapy is necessary for suspected gonococcal infection.

// Data from Chandra NS, Torres MF, Winthrop KL. Cluster of Mycobacterium chelonae keratitis cases following laser in-situ keratomileusis. Am J Ophthalmol 2001; 132:819–30.

## Blepharitis (Initial and Follow-up Evaluation)

### Initial Exam History

- Ocular symptoms and signs (e.g., redness, irritation, burning, tearing, itching, crusting of eyelashes, eyelid sticking, contact lens intolerance, photophobia, increased frequency of blinking) (III, GQ, SR)
- Time of day when symptoms are worse
- Duration of symptoms
- Unilateral or bilateral presentation
- Exacerbating conditions (e.g., smoke, allergens, wind, contact lenses, low humidity, retinoids, diet and alcohol consumption, eye makeup)
- Symptoms related to systemic diseases (e.g., rosacea, allergy) (III, IQ, DR)
- Current and previous systemic and topical medications (e.g., antihistamines or drugs with anticholinergic effects, or drugs used in the past that might have an effect on the ocular surface [e.g., isotretinoin]) (III, GQ, SR)
- Recent exposure to an infected individual (e.g., pediculosis palpebrarum [*Pthirus pubis*])
- Ocular history (e.g., previous intraocular and eyelid surgery, local trauma, including mechanical, thermal, chemical, and radiation injury, history of cosmetic blepharoplasty, history of styes and/or chalazia) (III, GQ, SR)

### Initial Physical Exam

- Visual acuity (III, GQ, SR)
- External examination
  - Skin (III, GQ, SR)
  - Eyelids (III, GQ, SR)
- Slit-lamp biomicroscopy
  - Tear film (III, GQ, SR)
  - Anterior eyelid margin (III, GQ, SR)
  - Eyelashes (III, GQ, SR)
  - Posterior eyelid margin (III, GQ, SR)
  - Tarsal conjunctiva (everting eyelids) (III, GQ, SR)
  - Bulbar conjunctiva (III, GQ, SR)
  - Cornea (III, GQ, SR)

### Diagnostic Tests

- Cultures may be indicated for patients with recurrent anterior blepharitis with severe inflammation as well as for patients who are not responding to therapy. (III, IQ, DR)
- Biopsy of the eyelid to exclude the possibility of carcinoma may be indicated in cases of marked asymmetry, resistance to therapy or unifocal recurrent chalazia that do not respond well to therapy. (III, IQ, DR)
- Consult with the pathologist prior to obtaining the biopsy if sebaceous cell carcinoma is suspected. (III, GQ, SR)

### Care Management

- Treat patients with blepharitis initially with a regimen of warm compresses and eyelid hygiene. (III, IQ, DR)
- A topical antibiotic such as bacitracin or erythromycin can be prescribed to be applied one or more times daily or at bedtime on the eyelids for one or more weeks. (III, IQ, DR)
- For patients with meibomian gland dysfunction, whose chronic symptoms and signs are not adequately controlled with eyelid hygiene, oral tetracyclines and topical antibiotics can be prescribed. (I-, MQ, DR)
- A brief course of topical corticosteroids may be helpful for eyelid or ocular surface inflammation. The minimal effective dose of corticosteroid should be utilized and long-term corticosteroid therapy should be avoided if possible. (III, GQ, SR)

### Follow-Up Evaluation

- Follow-up visits should include:
  - Interval history (III, GQ, SR)
  - Measurement of visual acuity (III, GQ, SR)
  - External examination (III, GQ, SR)
  - Slit-lamp biomicroscopy (III, GQ, SR)
- If corticosteroid therapy is prescribed, re-evaluate patient within a few weeks to determine the response to therapy, measure intraocular pressure, and assess treatment compliance (III, GQ, SR)

### Patient Education

- Counsel patients about the chronicity and recurrence of the disease process. (III, GQ, SR)
- Inform patients that symptoms can frequently be improved but are rarely eliminated. (III, GQ, SR)
- Patients with an inflammatory eyelid lesion that appears suspicious for malignancy should be referred to an appropriate specialist. (III, GQ, SR)

## Conjunctivitis (Initial Evaluation)

### Initial Exam History

- Ocular symptoms and signs (e.g., itching, discharge, irritation, pain, photophobia, blurred vision)
- Duration of symptoms and time course
- Exacerbating factors
- Unilateral or bilateral presentation
- Character of discharge
- Recent exposure to an infected individual
- Trauma (mechanical, chemical, ultraviolet)
- Mucus fishing
- Contact lens wear (lens type, hygiene and use regimen)
- Symptoms and signs potentially related to systemic diseases (e.g., genitourinary discharge, dysuria, dysphagia, upper respiratory infection, skin and mucosal lesions)
- Allergy, asthma, eczema
- Use of topical and systemic medications
- Ocular history (e.g., previous episodes of conjunctivitis and previous ophthalmic surgery)
- Compromised immune status
- Current and prior systemic diseases
- Social history (e.g., smoking, occupation and hobbies, travel and sexual activity)

### Initial Physical Exam

- Visual acuity (*III, IQ, DR*)
- External examination (*III, IQ, DR*)
  - Skin (signs of rosacea, eczema, seborrhea) (*III, IQ, DR*)
  - Abnormalities of the eyelids and adnexae (swelling, discoloration, malposition, laxity, ulceration, nodules, ecchymosis, neoplasia) (*III, IQ, DR*)
  - Conjunctiva (pattern of injection, subconjunctival hemorrhage, chemosis, cicatricial change, symblepharon, masses, discharge) (*III, IQ, DR*)

- Slit-lamp biomicroscopy (*III, IQ, DR*)
  - Eyelid margins (inflammation, ulceration, discharge, nodules or vesicles, blood-tinged debris, keratinization) (*III, IQ, DR*)
  - Eyelashes (loss of lashes, crusting, scurf, nits, lice, trichiasis) (*III, IQ, DR*)
  - Lacrimal puncta and canaliculi (pouting, discharge) (*III, IQ, DR*)
  - Tarsal and forniceal conjunctiva (*III, IQ, DR*)
  - Bulbar conjunctiva/limbus (follicles, edema, nodules, chemosis, laxity, papillae, ulceration, scarring, phlyctenules, hemorrhages, foreign material, keratinization) (*III, IQ, DR*)
  - Cornea (*III, IQ, DR*)
  - Anterior chamber/iris (inflammation reaction, synechiae, transillumination defects) (*III, IQ, DR*)
  - Dye-staining pattern (conjunctiva and cornea) (*III, IQ, DR*)

### Diagnostic Tests

- Cultures, smears for cytology and special stains are indicated in cases of suspected infectious neonatal conjunctivitis. (*II-, IQ, DR*)
- Smears for cytology and special stains are recommended in cases of suspected gonococcal conjunctivitis. (*II-, IQ, DR*)
- Confirm diagnosis of adult and neonate chlamydial conjunctivitis with immunodiagnostic test and/or culture.
- Biopsy the bulbar conjunctiva and take a sample from an uninvolved area adjacent to the limbus in an eye with active inflammation when ocular mucous membrane pemphigoid is suspected. (*II-, IQ, DR*)
- A full-thickness lid biopsy is indicated in cases of suspected sebaceous carcinoma. (*III, IQ, DR*)
- Confocal microscopy may be helpful to evaluate some forms of conjunctivitis (e.g., atopic, SLK). (*II-, MQ, DR*)
- Thyroid function tests are indicated for patients with SLK who do not have known thyroid disease. (*III, IQ, DR*)

## Conjunctivitis (Management Recommendations)

### Care Management

- Avoid indiscriminate use of topical antibiotics or corticosteroids because antibiotics can induce toxicity and corticosteroids can potentially prolong adenoviral infections and worsen herpes simplex virus infections (*III, GQ, SR*)
- Treat mild allergic conjunctivitis with an over-the-counter antihistamine/vasoconstrictor agent or second-generation topical histamine H1-receptor antagonists. If the condition is frequently recurrent or persistent, use mast-cell stabilizers (*I++*, *GQ, SR*)
- For contact lens-related keratoconjunctivitis, discontinue contact lens wear for 2 or more weeks (*III, IQ, DR*)
- If corticosteroids are indicated, prescribe the lowest potency and frequency based on patient response and tolerance (*III, IQ, DR*)
- If corticosteroids are used, perform baseline and periodic measurement of intraocular pressure and pupillary dilation (*III, IQ, DR*)
- Use systemic antibiotic treatment for conjunctivitis due to *Neisseria gonorrhoeae* or *Chlamydia trachomatis* (*III, IQ, DR*)
- Treat sexual partners to minimize recurrence and spread of disease when conjunctivitis is associated with sexually transmitted diseases and refer patients and their sexual partners to an appropriate medical specialist (*III, GQ, SR*)
- Refer patients with manifestation of a systemic disease to an appropriate medical specialist (*III, GQ, SR*)

### Follow-Up Evaluation

- Follow-up visits should include
  - Interval history (*III, IQ, DR*)
  - Visual acuity (*III, IQ, DR*)
  - Slit-lamp biomicroscopy (*III, IQ, DR*)
- If corticosteroids are used, perform periodic measurement of intraocular pressure and pupillary dilation to evaluate for cataract and glaucoma (*III, IQ, DR*)

### Patient Education

- Counsel patients with contagious varieties to minimize or prevent spread of diseases in the community (*III, IQ, DR*)
- Inform patients who may require repeat short-term therapy with topical corticosteroid of potential complications of corticosteroid use
- Advise patients with allergic conjunctivitis that frequent clothes washing and bathing/showering before bedtime may be helpful (*III, IQ, DR*)

## Corneal Ectasia (Initial and Follow-up Evaluation)

### Initial Exam History

- Disease onset and course
- Vision impairment
- Ocular, medical, and family history

### Initial Physical Exam

- Visual function assessment
- External examination
  - Corneal protrusion
  - Eyelids and periorbital skin
- Slit-lamp biomicroscopy
  - Presence, extent, and location of the corneal thinning or protrusion
  - Indication of previous ocular surgery
  - Presence of Vogt striae, prominent corneal nerves, Fleischer ring, or other iron deposition
  - Evidence of corneal scarring or previous hydrops, and presence of prominent corneal nerves
- IOP measurement (III, IQ, DR)
- Fundus examination: assessment of red reflex for dark area, and retina for tapetoretinal degenerations (III, IQ, DR)

### Diagnostic Tests

- Keratometry (II+, MQ, DR)
- Corneal topography (II-, MQ, SR)
- Topographic power map
- Topographic elevation map (II+, MQ, DR)
- Corneal pachymetry (II++, GQ, SR)

### Care Management

- Therapy is tailored to the individual patient, depending on the visual impairment and treatment option(s).
- Vision can be corrected with eyeglasses, but contact lenses may be required as keratoconus progresses.
- Rigid corneal gas permeable contact lenses can mask corneal irregularities. New hybrid contact lenses provide higher oxygen permeability and greater RGP/hydrogel junction strength. Piggyback contact lenses may be employed in cases of corneal scarring or decentered cones. Scleral lenses may be indicated when RGP and/or hybrid contact lenses fail.
- Intrastromal corneal ring segment implantation can improve contact lens tolerance and BCVA for patients with corneal ectasia, a clear cornea, and contact lens intolerance. (II-, MQ, DR)

- Collagen crosslinking can improve corneal rigidity by increasing bonds between fibers.
- Lamellar keratoplasty using DALK techniques can be considered for progressive keratoconus without significant scarring or hydrops. (II++, MQ, DR) Crescentic lamellar keratoplasty is an option when maximal thinning is in the cornea's periphery. (III, IQ, DR)
- Peripheral thinning and ectasia can be managed by a standard decentered lamellar procedure for tectonic support, followed by a central penetrating keratoplasty later. (III, IQ, DR)
- Penetrating keratoplasty is indicated when a patient can no longer achieve functional vision with eyeglasses or contact lenses, or when persistent corneal edema occurs following hydrops. (III, IQ, DR) Descemet stripping endothelial keratoplasty cannot correct ectatic disorder. (III, IQ, DR)
- Penetrating keratoplasty is preferred over DALK in cases of deep stromal scarring. (III, IQ, DR)
- A lamellar graft can be performed for tectonic support when ectasia occurs in the far periphery of the cornea. (III, IQ, DR)

### Follow-Up Evaluation

- Follow-up evaluation and visit intervals are dictated by treatment and disease progression. (III, IQ, DR)
- Annual follow up is recommended for cases of ectasia unless the patient has significant changes in visual function. (III, IQ, DR)
- Patients should be made aware of the warning signs of rejection and should seek medical attention promptly if symptoms occur. (III, GQ, SR) The practitioner should be aware of the slit-lamp biomicroscopic findings of epithelial, stromal, and endothelial rejection. (III, GQ, SR)

### Counseling and Referral

- When medical therapy with eyeglasses and/or contact lenses cannot improve visual function, a referral to an ophthalmologist trained in surgical treatments for corneal ectasia is indicated (III, GQ, SR)
- Patients with a history of allergy and atopy may require a referral to a dermatologist or allergist (III, GQ, SR)
- Patients with floppy eyelid disease may be best managed by an oculoplastics specialist and referrals to other medical specialists may also be needed (III, GQ, SR)



## Corneal Edema and Opacification (Initial Evaluation)

### Initial Exam History

- Symptoms: blurred or variable vision; photophobia; redness; tearing; intermittent foreign body sensation; pain
- Age of onset
- Rapidity of onset
- Persistence
- Unilateral or bilateral presentation
- Moderating factors, like visual improvement related to environmental factors
- Past ocular and medical history
- Topical and systemic medications
- Trauma
- Contact lens wear
- Family and social history

### Initial Physical Exam

- Visual function assessment
- External examination
  - Evidence of proptosis, ptosis, lagophthalmos, or floppy eyelid syndrome
  - Eyelid or facial asymmetry, scarring, and malfunction
- Slit-lamp biomicroscopy (*III, IQ, DR*)
  - Unilateral or bilateral signs
  - Diffuse or localized edema
  - Primarily epithelial or stromal edema
  - Evidence of epithelial breakdown, stromal infiltration, epithelial ingrowth, striae, focal thickening, thinning, scarring, interface haze, striae or inflammation, or stromal vascularization
  - Evidence of guttae, Descemet's membrane tear or detachment, endothelial vesicles, keratic precipitates (KP), pigment peripheral anterior synechiae
  - Involvement of host or donor tissue
  - Evidence of sectoral corneal edema and KPs, or an anterior chamber reaction
  - Status, shape, and position of the pupil and iris
  - Evidence of vitreous strands or pigment dusting
  - Status and position of the lens
- IOP measurement
- Fundus examination
- Gonioscopy

### Diagnostic Tests

- Potential acuity meter
- Rigid contact lens overrefraction
- Pachymetry (*III, IQ, DR*)
- Scheimpflug imaging
- Specular and confocal microscopy (*III, IQ, DR*)
- Anterior segment optical coherence tomography (*III, IQ, DR*)
- Ultrasound biomicroscopy

## Corneal Edema and Opacification (Management Recommendations)

### Care Management

- Therapeutic goal is to control the cause of corneal edema or opacity and enhance a patient's quality of life by improving visual acuity and comfort
- Treatment starts with medical management, but surgery may be ultimately required
- Corneal edema: medical management
  - Lowering an elevated IOP is helpful
  - Topical carbonic anhydrase inhibitors should not be the first line of therapy when endothelial dysfunction is suspected (*II-, MQ, SR*)
  - Topical corticosteroid can control inflammation once infection has been ruled out (*III, GQ, SR*)
  - Microcystic or bullous epithelial disease may produce discomfort or pain necessitating the placement of a bandage contact. (*III, GQ, SR*) Periodic lens exchange is advised for longer-term use. (*III, IQ, DR*)
- Corneal edema: surgical management
  - Patients with corneal edema and persistent discomfort, but limited or no visual potential, are generally better candidates for the following procedures:
    - Phototherapeutic keratectomy (*III, IQ, DR*)
    - Conjunctival flap of Gunderson (*III, IQ, DR*)
    - Corneal transplantation
    - Endothelial keratoplasty
    - Penetrating keratoplasty (*III, GQ, SR*)
- Corneal opacification: medical management
  - Corneal opacity treatment can be divided into two phases: a) management of the principal, initiating process (i.e., infection, trauma), and b) management of the resulting problems (i.e., surface erosions and irregularity, scarring, thinning, and vascularization)
  - Conventional treatment involves an antibiotic drop or ointment to protect against secondary bacterial infection (*III, IQ, DR*)
  - Temporary glue, suture tarsorrhaphy, or lid splints can be helpful when blinking or lid closure is inadequate (*III, IQ, DR*)
  - A bandage contact lens may be useful in cases of delayed healing (*III, GQ, SR*)
  - A rigid gas permeable lens — or hybrid or scleral lens when greater stability is needed — will often improve vision when surface irregularity is a factor; such lenses may preclude the need for more invasive procedures (*III, IQ, DR*)
- Corneal opacification: surgical management
  - Surgical strategy for managing corneal opacities depends on the tissue layer(s) involved:
    - Epithelial debridement is most helpful with lesions anterior to Bowman's layer (*III, IQ, DR*)
    - Ethylenediaminetetraacetic acid (EDTA) may be used to remove calcific band keratopathy (*III, IQ, DR*)
    - Mitomycin-C for subepithelial, Bowman's layer, and anterior stromal scarring may help in cases of possible recurrence (*III, IQ, DR*)
    - Corneal tattooing can mask cosmetically objectionable corneal leukomas
    - Anterior corneal lesions, extending beyond Bowman's layer into the anterior and mid-stroma, require more extensive treatment, such as superficial keratectomy, lamellar or penetrating keratoplasty, and keratoprosthesis (*III, GQ, SR*)

### Follow-Up Evaluation

- In the management of corneal edema, follow up is essential to monitor endothelial dysfunction
- In the management of corneal opacification, follow up to monitor corneal clarity and surface irregularity is necessary (*III, GQ, SR*)
- Coexisting problems, particularly intraocular inflammation and IOP, need regular reassessment (*III, GQ, SR*)

### Counseling and Referral

- Detailed discussion of the causes of edema or opacity, and various treatment options, is important. (*III, GQ, SR*)
- Referral to a corneal subspecialist is recommended when sophisticated diagnostic or medical management approaches are required (i.e., in cases exceeding the training of the treating physician). (*III, GQ, SR*) Referrals to retina, glaucoma, or pediatric ophthalmic subspecialists may also be needed. (*III, GQ, SR*) Once the condition has been resolved, or has stabilized, referral back to the comprehensive ophthalmologist is appropriate. (*III, GQ, SR*)
- When the disease process or management is complex, every effort should be made to counsel the patient regarding such challenges to allow for appropriate expectations and informed decision-making. (*III, GQ, SR*)

## Dry Eye Syndrome (Initial Evaluation)

### Initial Exam History

- Ocular symptoms and signs (e.g., irritation, tearing, burning, stinging, dry or foreign body sensation, mild itching, photophobia, blurry vision, contact lens intolerance, redness, mucous discharge, increased frequency of blinking, eye fatigue, diurnal fluctuation, symptoms that worsen later in the day) *(III, GQ, SR)*
- Exacerbating conditions (e.g., wind, air travel, decreased humidity, prolonged visual efforts associated with decreased blink rate such as reading and computer use) *(III, GQ, SR)*
- Duration of symptoms *(III, GQ, SR)*
- Ocular history, including
  - Topical medications used and their effect on symptoms (e.g., artificial tears, “eyewash,” antihistamines, glaucoma medications, vasoconstrictors, corticosteroids, homeopathic or herbal preparations) *(III, GQ, SR)*
  - Contact lens wear, schedule and care *(III, GQ, SR)*
  - Allergic conjunctivitis *(III, GQ, SR)*
  - Ocular surgical history (e.g., prior keratoplasty, cataract surgery, keratorefractive surgery) *(III, GQ, SR)*
  - Ocular surface disease (e.g., herpes simplex virus, varicella zoster virus, ocular mucous membrane pemphigoid, Stevens-Johnson syndrome, aniridia, graft-versus-host disease) *(III, GQ, SR)*
  - Punctal surgery *(III, GQ, SR)*
  - Eyelid surgery (e.g. prior ptosis repair, blepharoplasty, entropion/ectropion repair) *(III, GQ, SR)*
  - Bell palsy *(III, GQ, SR)*
- Medical history, including
  - Smoking or exposure to second-hand smoke *(II+, GQ, SR)*
  - Dermatological diseases (e.g., rosacea, psoriasis) *(II++, GQ, SR)*
  - Technique and frequency of facial washing including eyelid and eyelash hygiene *(II++, GQ, SR)*
  - Atopy *(II++, GQ, SR)*
  - Menopause *(II++, GQ, SR)*
  - Systemic inflammatory diseases (e.g., Sjögren syndrome, graft-versus-host disease, rheumatoid arthritis, systemic lupus erythematosus, scleroderma) *(II++, GQ, SR)*
  - Other systemic conditions (e.g., lymphoma, sarcoidosis) *(II++, GQ, SR)*
  - Systemic medications (e.g., antihistamines, diuretics, hormones and hormonal antagonists, antidepressants, cardiac antiarrhythmic drugs, isotretinoin, diphenoxylate/atropine, beta-adrenergic antagonists, chemotherapy agents, any other drug with anticholinergic effects) *(II++, GQ, SR)*
  - Trauma (e.g., mechanical, chemical, thermal) *(II++, GQ, SR)*
  - Chronic viral infections (e.g., hepatitis C, human immunodeficiency virus) *(II++, GQ, SR)*

- Nonocular surgery (e.g., bone marrow transplant, head and neck surgery, trigeminal neuralgia surgery) *(II++, GQ, SR)*
- Radiation of orbit *(II++, GQ, SR)*
- Neurological conditions (e.g., Parkinson disease, Bell palsy, Riley-Day syndrome, trigeminal neuralgia) *(II++, GQ, SR)*
- Dry mouth, dental cavities, oral ulcers *(II++, GQ, SR)*
- Fatigue *(II++, GQ, SR)*
- Joint pain, muscle aches *(II++, GQ, SR)*

### Initial Physical Exam

- Visual acuity
- External examination
  - Skin (e.g., scleroderma, facial changes consistent with rosacea, seborrhea)
  - Eyelids (incomplete closure/malposition, incomplete or infrequent blink, eyelid lag, erythema of eyelid margins, abnormal deposits or secretions, entropion, ectropion)
  - Adnexa (enlargement of the lacrimal glands)
  - Proptosis
  - Cranial nerve function (e.g., cranial nerve V [trigeminal], cranial nerve VII [facial])
  - Hands (joint deformities characteristic of rheumatoid arthritis, Raynaud phenomenon, splinter hemorrhage underneath nails)
- Slit-lamp biomicroscopy
  - Tear film (height of the meniscus, debris, increased viscosity, mucus strands, and foam break-up time and pattern)
  - Eyelashes (trichiasis, distichiasis, madarosis, deposits)
  - Anterior and posterior eyelid margins (abnormalities of meibomian glands [e.g., orifice metaplasia, reduced expressible meibum, atrophy], character of meibomian gland secretions [e.g., turbid, thickened, foamy, deficient], vascularization crossing the mucocutaneous junction, keratinization, scarring)
  - Puncta (patency, position, presence, and position of plugs)
  - Inferior fornix and tarsal conjunctiva (e.g., mucous threads, scarring, erythema, papillary reaction, follicle enlargement, keratinization, foreshortening, symblepharon)
  - Bulbar conjunctiva (e.g., punctate staining with rose bengal, lissamine green, or fluorescein dyes; hyperemia; localized drying; keratinization, chemosis, chalosis, follicles)
  - Cornea (localized interpalpebral drying, punctate epithelial erosions, punctate staining with rose bengal or fluorescein dyes, filaments, epithelial defects, basement membrane irregularities, mucous plaques, keratinization, pannus formation, thinning, infiltrates, ulceration, scarring, neovascularization, evidence of corneal or refractive surgery)

## Dry Eye Syndrome (Management Recommendations)

### Care Management

- Treat any causative factors that are amenable to treatment as patients with dry eye symptoms often have many contributory factors
- Sequence and combination of therapies is determined based on the patient's needs and preferences and the treating ophthalmologist's medical judgment *(III, GQ, SR)*
- For mild dry eye, the following measures are appropriate:
  - Education and environmental modifications *(III, GQ, SR)*
  - Elimination of offending topical or systemic medications *(III, IQ, DR)*
  - Aqueous enhancement using artificial tear substitutes, gels/ointments *(III, IQ, DR)*
  - Eyelid therapy (warm compresses and eyelid hygiene) *(III, IQ, DR)*
  - Treatment of contributing ocular factors such as blepharitis or meibomianitis *(II++, GQ, DR)*
  - Correction of eyelid abnormalities *(II++, MQ, DR)*
- For moderate dry eye, in addition to above treatments, the following measures are appropriate:
  - Anti-inflammatory agents (topical cyclosporine and corticosteroids, systemic omega-3 fatty acids supplements)
  - Punctal plugs *(I++, GQ, SR)*
  - Spectacle side shields and moisture chambers *(III, GQ, SR)*
- For severe dry eye, in addition to above treatments, the following measures are appropriate:
  - Systemic cholinergic agonists
  - Systemic anti-inflammatory agents
  - Mucolytic agents *(III, IQ, DR)*
  - Autologous serum tears
  - Contact lenses
  - Correction of eyelid abnormalities
  - Permanent punctal occlusion *(III, IQ, DR)*
  - Tarsorrhaphy *(III, IQ, DR)*
- Monitor patients prescribed corticosteroids for adverse effects such as increased intraocular pressure, corneal melting, and cataract formation *(III, GQ, SR)*

### Patient Education

- Counsel patients about the chronic nature of dry eye and its natural history. *(III, GQ, SR)*
- Provide specific instructions for therapeutic regimens. *(III, GQ, SR)*
- Reassess periodically the patient's compliance and understanding of the disease, risks for associated structural changes and realistic expectations for effective management, and reinforce education. *(III, GQ, SR)*
- Refer patients with manifestation of a systemic disease to an appropriate medical specialist. *(III, GQ, SR)*
- Caution patients with pre-existing dry eye that keratorefractive surgery, particularly LASIK, may worsen their dry eye condition. *(III, GQ, SR)*