

# External Disease, Cornea, Cataract, Refractive surgery

## I. External Disease and Cornea

### Objectives

Diagnosis and differentiation between congenital, inflammatory (infectious), degenerative, tumoral, traumatic and immunological corneal conditions using the following methods:

- Clinical examination and medical history
- Morphological documentation
- Laboratory tests corresponding to other potential investigations

### Anatomy and physiology of:

- Basic anatomy, embryology, physiology, pathology, microbiology, immunology, genetics, epidemiology and pharmacology of the cornea, conjunctiva, sclera, eyelids, lacrimal apparatus and ocular adnexa.
- Fundamentals of corneal optics and refraction (e.g., [irregular] astigmatism, keratoconus, anisometropia, keratometry, topography, irregular astigmatism, keratoconus, post-keratoplasty refraction).
- Congenital abnormalities of the cornea, sclera and globe and their associated systemic manifestations (e.g. microphthalmos, birth trauma, buphthalmos, aniridia, hamartomas and choristomas), sclerocornea, blue sclerae and other developmental anterior segment abnormalities (e.g., Axenfeld's, Rieger's, Peter's anomalies and related syndromes).
- Corneal and conjunctival degenerations (e.g., band keratopathy, neurotropic keratopathy, keratoconus, Salzmann's degeneration, inflamed, atypical, or recurrent pterygium, pinguecula, senile plaques of the sclera)
- Conjunctival neoplasms (e.g., benign and malignant tumours, pyogenic granulomas)
- Corneal dystrophies (e.g., map-dot-fingerprint dystrophy, Meesman dystrophy, Reis-Buckler's dystrophy, Francois syndrome, Schnyder's crystalline dystrophy, congenital hereditary stromal dystrophy, lattice dystrophy, granular dystrophy, macular dystrophy, congenital hereditary endothelial dystrophy, Fuchs' dystrophy, posterior polymorphous dystrophy)
- Superficial punctate keratitis (e.g., dry eye, blepharitis, toxicity, ultraviolet photokeratopathy, contact lens related and rare diseases)
- Corneal and conjunctival inflammations and infections (e.g., staphylococcal hypersensitivity, simple microbial keratitis, trachoma, ophthalmia neonatorum, herpes zoster ophthalmicus, herpes simplex keratitis, keratouveitis and conjunctivitis, syphilis, interstitial keratitis, rosacea keratitis)
- Basic presentations of ocular allergy

(e.g., phlyctenules, chemosis, seasonal hay fever, vernal conjunctivitis, allergic and atopic conjunctivitis, giant papillary conjunctivitis)

### Clinical knowledge of diagnosis, pathology and treatment:

- Characteristic corneal and conjunctival degenerations (e.g., pterygium, pinguecula, Salzmann nodular degeneration, senile plaques of the sclera).
- Classic corneal dystrophies (e.g., map-dot-fingerprint dystrophy, lattice dystrophy, granular dystrophy, macular dystrophy, Fuchs' dystrophy).
- Corneal or conjunctival presentations of degenerations and common conjunctival neoplasms (e.g., inflamed, atypical, or recurrent pterygium, band keratopathy, benign and malignant tumours).
- Fundamentals of ocular microbiology and recognise corneal and conjunctival inflammations and infections (e.g., staphylococcal hypersensitivity, simple microbial keratitis, fungal corneal ulcers, trachoma, ophthalmia neonatorum, herpes zoster ophthalmicus, herpes simplex keratitis, adenovirus keratoconjunctivitis and conjunctivitis). Ocular microbiology and complicated corneal and conjunctival infections (e.g., normal conjunctival bacterial flora, complex, mixed, or atypical bacterial, fungal, Acanthamoeba, viral, or parasitic keratitis). Interstitial keratitis (e.g., syphilis, viral diseases, non-infectious, post-infectious, immunologic, inflammation)
- Basic principles of ocular pharmacology of anti-infective, anti-inflammatory and immune-modulating agents (e.g., indications and contraindications for topical corticosteroids, nonsteroidal anti-inflammatory agents and antibiotics, anti-infective, anti-inflammatory and immune-modulating agents, use of topical nonsteroidal and steroidal agents, cyclosporine and anti-tumour necrosis factor agents).
- Recognise and treat lid margin disease (e.g., staphylococcal blepharitis, meibomian gland dysfunction).
- Basic differential diagnosis of acute and chronic conjunctivitis or red eye (e.g., scleritis, episcleritis, conjunctivitis, orbital cellulitis, gonococcal and chlamydial conjunctivitis).
- Pyogenic granuloma.
- Basic presentations of ocular allergy (e.g., phlyctenules, seasonal hay fever, vernal conjunctivitis, allergic and atopic conjunctivitis, giant papillary conjunctivitis).
- Epidemiology, clinical features, pathology, evaluation and treatment of peripheral corneal thinning disorders or ulceration (e.g., Terrien marginal degeneration, Mooren ulcer, rheumatoid arthritis-related corneal melt, dellen).
- Epidemiology, differential diagnosis, evaluation and management of vitamin A deficiency (e.g., Bitot spot, dry eye, slowed dark adaptation) and neurotrophic corneal diseases.
- Recurrent corneal erosions.
- Differential diagnosis of red eye (e.g., autoimmune and inflammatory disorders causing scleritis, episcleritis, conjunctivitis, orbital cellulitis).
- Features of trachoma, including epidemiology, clinical features and staging, and its complications (e.g., cicatrization), prevention (e.g., facial hygiene) and topical and systemic antibiotic treatment
- Differential diagnosis, evaluation and treatment of interstitial keratitis (e.g., syphilis, viral diseases, non-infectious, immunologic, inflammation).

- Chronic conjunctivitis (e.g., chlamydia, trachoma, molluscum contagiosum, Parinaud oculoglandular syndrome, ocular rosacea).
- Understand the mechanisms of ocular immunology and recognise the external manifestations of anterior segment inflammation (e.g., red eye associated with acute and chronic iritis).
- Symptoms, signs, testing and evaluation for dry eye (e.g., Schirmer test, tarsorrhaphy); and treatment for dry eye.
- Aetiologies and treatment of superficial punctate keratopathy
- Aetiologies of hyphema and microhyphema.
- Basic mechanisms of traumatic and toxic injury to the anterior segment and treatment (e.g., chemical and thermal burns, lid laceration, orbital fracture).
- Corneal lacerations (perforating and non-perforating), anterior segment trauma, corneal and conjunctival foreign bodies.
- Epidemiology, differential diagnosis, evaluation and management of common benign and malignant lid lesions, including pigmented lesions of the conjunctiva and lid (e.g., nevi, melanoma, primary acquired melanosis, ocular surface squamous neoplasia).
- Ocular cicatricial pemphigoid and Stevens-Johnson syndrome

#### Clinical knowledge of ancillary testing and treatment:

- External examination (illuminated and magnified) and slit-lamp biomicroscopy, including drawing of anterior segment findings.
- Tests for dry eye (e.g., Schirmer test, tear film breakup and dye disappearance).
- Punctal occlusion (temporary or permanent) or insert plugs.
- Corneal sensation testing (e.g., cotton-tipped swab).
- Techniques of sampling for viral, bacterial, fungal and protozoal ocular infections (e.g., corneal scraping and appropriate culture techniques).
- Stains of the cornea and conjunctiva (e.g., Gram stain, Giemsa stain).
- Corneal epithelial defects (e.g., pressure patching and bandage contact lenses).
- Pterygium excision (e.g., with autologous conjunctival transplantation).
- Classification, pathology, indications for surgery and prognosis of common eyelid abnormalities (e.g., blepharoptosis, trichiasis, distichiasis, essential blepharospasm, entropion, ectropion) and understand their relationship to secondary diseases of the cornea and conjunctiva (e.g., exposure keratopathy).
- Corneal lacerations (perforating and non-perforating).
- Indications for ocular surface transplantation, including conjunctival autograft/flap, amniotic membrane transplantation and limbal stem cell transplantation.
- Surgical indications (e.g., Fuchs' dystrophy, aphakic/pseudophakic bullous keratopathy, keratoconus), surgical techniques and recognition and management of postoperative complications (especially immunologically-mediated rejection) of corneal transplantation (e.g., penetrating, lamellar).
- Anterior segment surgery including eyelid, conjunctival, scleral and corneal procedures, with emphasis on corneal protective procedures (e.g., tarsorrhaphy), reconstruction of the ocular surface, surgical management of corneal erosions and phototherapeutic keratectomy.
- Penetrating and lamellar keratoplasty, with emphasis on patient selection, surgical technique and postoperative care, including recognition and management of graft

rejection and endophthalmitis and advanced techniques for lamellar and penetrating keratoplasty, including full thickness and lamellar transplants and endothelial keratoplasty.

- Pterygium excision with graft, corneal and conjunctival biopsies, astigmatic keratotomies and phototherapeutic keratectomy.
- Conjunctival reconstruction, amniotic membrane transplantation, ocular surface neoplasia and limbal stem cell transplantation.

## II. Cataract

### Objectives

Diagnosis and differentiation between different lens pathologies with emphasis on cataract using the following methods:

- Clinical examination and medical history
- Morphological documentation
- IOL selection and calculation
- Surgical decision and management

### Anatomy and physiology of:

- lens anatomy, physiology and accommodation
- Causes and types of cataract (e.g., anterior polar, cortical, nuclear sclerotic, posterior subcapsular, posterior polar, mature lenses such as the Morgagnian cataract, spherophakia, lenticonus, ectopia lentis, coloboma).

### Clinical knowledge of ancillary testing:

Principles and mechanisms of the following instruments in the evaluation of cataract:

Slit-lamp biomicroscope  
Glare and contrast testing devices  
Keratometers and biometers

Basics of IOL power estimation, including:

- a. Linear regression formulas (e.g., Sanders-Retzlaff-Kraff [SRK] and SRKII)

Methods to estimate axial eye length, including:

- a. Contact ultrasound
  - b. Immersion ultrasound
  - c. IOLMaster, LENSTAR, or equivalent
- Use of A-scan and B-scan contact and immersion ultrasonography and optical coherence techniques in cataract surgery to measure axial eye length.

### Clinical knowledge of diagnosis and pathology:

- Relationship between the lens and systemic disease (e.g., diabetes, myotonic dystrophy).
- Ocular conditions that are associated with cataract (e.g., uveitis, Wilson disease, ocular ischaemia, ocular tumours, including treatment for tumours such as radiotherapy).
- Systemic and topical medicine that can cause pathologic changes in the lens (e.g., oral and topical corticosteroid use).
- Major aetiologies of dislocated or subluxated lens (e.g., pseudoexfoliation syndrome, trauma, Marfan syndrome, homocystinuria, Weill-Marchesani syndrome, syphilis).
- Classify common types of lens opacities.
- Level of visual acuity with the lens or capsular opacities.

### Clinical knowledge of treatment

- List the steps of routine intracapsular cataract extraction (ICCE), ECCE and phacoemulsification.
- Methods to decrease postoperative infection, including presurgical preparation, intraoperative antibiotics and postoperative antibiotic techniques.
- Postoperative medications used for cataract surgery, including antibiotics, nonsteroidal anti-inflammatory drugs and corticosteroid therapy.
- Risk factors for intraoperative floppy iris syndrome (IFIS) and intraoperative techniques to limit the risk of this syndrome (e.g., alpha blockers, use of rings, hooks).
- Special considerations when dealing with a unilateral cataract (trauma, history of uveitis, history of topical steroid use, past surgeries).
- History and examination steps for preoperative cataract and posterior capsular opacification evaluation.
- Posterior capsule opacification.
- Basic steps of cataract surgery (e.g., incision, wound closure) in the practice lab, if available.
- Basic preparatory procedures for cataract surgery (e.g., obtaining informed consent, identification of instruments)
- Steps of cataract surgery under direct supervision, including any or all of the following:
  - a. Wound construction
  - b. Anterior capsulotomy/capsulorhexis
  - c. Instillation and removal of viscoelastics
  - d. Hydrodissection and hydrodelineation
  - e. Extracapsular and phacoemulsification techniques
  - f. Irrigation and aspiration
  - g. Cortical clean-up
  - h. IOL implantation (e.g., anterior and posterior)
  - i. Removal of viscoelastic
  - j. Suturing of the wound
  - k. Wound hydration

- Preoperative evaluation of the cataract patient, including:
  - a. Systemic diseases of interest or relevance to cataract surgery
  - b. Systemic medication of relevance to cataract surgery (e.g., alpha 1 adrenergic blocking agent, blood thinning agents, corticosteroids)
  - c. Relationship of external and corneal diseases of relevance to cataract and cataract surgery (e.g., lid abnormalities, dry eye)
  - d. Management of uveitis prior to and following cataract surgery
  - e. Management of glaucoma prior to and following cataract surgery, including options for postoperative intraocular pressure (IOP) control
  
- Instruments and techniques of cataract extraction, including extracapsular surgery and phacoemulsification.
- Important parameters of the phacoemulsification machine and how to alter them for particular conditions of surgery.
- Types, indications and techniques of anaesthesia for cataract surgery (e.g., topical, local, general).
- Indications, techniques and complications of surgical procedures, including: ECCE, ICCE, phacoemulsification, paracentesis and IOL placement.
- Pathogenesis and strategies for prevention of posterior capsular opacification.
- Pathogenesis, clinical presentation, differential diagnosis, evaluation, clinical course, treatment and outcome of the common complications of cataract and anterior segment surgery (e.g., intraoperative floppy iris syndrome, corneal oedema, IOP elevation, hyphema, endophthalmitis, toxic anterior segment syndrome (TASS), cystoid macular oedema (CME), retinal detachment, IOL dislocation, lens-induced glaucoma, uveitis).
- Indications for, principles of and techniques of yttrium aluminium garnet (YAG) laser capsulotomy, and understand the proper timing of YAG laser capsulotomy.
- Advanced IOL power calculation (e.g., after radial keratotomy [RK], myopic laser-assisted in situ keratomileusis [LASIK]/photorefractive keratectomy [PRK], hyperopic LASIK/PRK).
- Properties of different ophthalmic viscoelastic devices (OVDs) (e.g., dispersive, cohesive, adaptive) and the advantages and disadvantages for certain phases of surgery.
- Fluid dynamics in phacoemulsification, including the difference between peristaltic and venture pump types.
- Common postoperative complications of cataract surgery (e.g., endophthalmitis, TASS, elevated IOP, CME, wound leak, uveitis, capsular block syndrome).
- Complex indications for cataract surgery (e.g., better view of posterior segment, lens-induced glaucoma).
- Techniques to manage a small pupil, including mechanical manipulation, management of iris membrane, iris hooks, viscoelastic and phaco techniques.
- Diagnose and operate on patients with posterior polar cataract.
- Preoperative preparations for surgery and special intraoperative considerations for patients with uveitis.
- Complications of more advanced anterior segment surgery (e.g., pseudoexfoliation, small pupils, intraoperative floppy iris syndrome, mature cataract, hard nucleus, post-traumatic, zonular dehiscence, cataract surgery after pars plana vitrectomy, short eye, corneal endothelial diseases).

- Special devices for cataract surgery in complex situations such as specialised IOLs, capsular tension rings and segments, iris hooks, Malyugin ring, use of indocyanine green/trypan blue staining of the anterior capsule.
- IOL fixation options in the lack of capsular support for in-the-bag fixation (anterior chamber [AC] IOL, sulcus fixation +/- optic capture, iris fixation, scleral fixation).
- Indications for, techniques of and complications of cataract extraction in the context of the subspecialty disciplines of the following:
  - Glaucoma (e.g., combined cataract and glaucoma procedures, glaucoma in cataractous eyes, cataract surgery in patients with prior glaucoma surgery)
  - Retina (e.g., cataract surgery in patients with scleral buckles or prior vitrectomy)
  - Cornea (e.g., cataract extraction in patients with corneal opacities) and the use of fibre optic for better visualisation
- Ophthalmic plastic surgery (e.g., ptosis following cataract surgery)
- Refractive surgery (e.g., cataract surgery in eyes that have undergone refractive surgery)
- Management plan for complications of cataract and IOL implant surgery (e.g., posterior capsular tears, vitreous prolapse, intravitreal dislocation of cataractous fragments, corneal wound burn, expulsive haemorrhage, choroidal effusions, damage to the iris tissue).
- Instrumentation and techniques used to implant foldable and non-foldable IOLs.
- Evaluation and management of common and uncommon causes of postoperative endophthalmitis and TASS.
- Causes and indication for performing, repositioning, removal, or exchange of IOLs.
- Astigmatism management during cataract surgery (e.g., on-axis incision, limbal-relaxing incisions [LRI], opposite clear corneal incision [OCCI], toric IOL).
- Corneal topography and wavefront analysis to help select the best type of IOL for a patient especially following keratorefractive surgery.
- Presbyopic correction solutions during cataract surgery (e.g., monovision, multifocal IOLs, accommodative IOLs, dual-optic IOLs).
- Mechanisms of actions, indications, contraindications, advantages and disadvantages of premium IOLs (e.g., multifocal, accommodative, toric, aspheric, blue blocker, intraocular miniature telescope).
- Management of IOL complications (e.g., intraoperative damage to IOL, postoperative IOL opacification, dislocation, sublocation).
- Advantages and disadvantages of the materials used for IOL fabrication (e.g., polymethylmethacrylate [PMMA], silicone, hydrophobic acrylic, hydrophilic acrylic).
- Lens/IOL surgery solutions for myopia and hyperopia (e.g., refractive lens exchange, phakic IOLs).
- Paediatric cataract surgery, including the indications for surgery (posterior capsulotomy +/- anterior vitrectomy), IOL implantation, unilateral and bilateral congenital cataract and IOL calculation in young children.
- Management of cataract associated with aniridia.
- Treatment options for "dropped IOL" and indications for referral to a vitreoretinal surgeon.
- Advantages and strategies for advanced phacoemulsification techniques such as torsional or transversal ultrasound, small-incision and microincision cataract surgery (MICS), biaxial MICS cataract surgery.
- Indications for triple procedures or combined surgeries (e.g., phaco plus trabeculectomy, keratoplasty, silicone-oil removal).
- Indications for "premium" IOLs (e.g., multifocal, accommodating, toric).

- Surgical difficulties of hypermature (Morgagnian) cataract.
- Treatment options for eyes with shallow anterior chamber and cataract including high-degree hyperopic eyes and piggyback IOL implantation.
- Methods to determine typical surgically induced astigmatism and surgeon specific A-constant.
- Aetiology and management of unexpected postoperative refractive errors, including hyperopic and myopic shifts (e.g., capsular phimosis, capsular block, upside-down IOL).
- Management strategies to reposition of decentred, tilted, subluxated and dislocated IOLs.

### III. Refractive surgery

#### Objectives

Diagnosis and differentiation between different refractive errors with their clinical presentation, associated pathology and modality for correction.

- Objective and subjective refraction
- Clinical examination and medical history
- Prescription of correction
- Surgical decision and management

#### Anatomy and physiology of:

- Types of refractive errors:
  - a. Myopia
  - b. Hyperopia
  - c. Astigmatism
  - d. Presbyopia
- Basic optic principles, such as line of sight and Purkinje image.
- Theories of accommodation.
- Basics of ophthalmic optics, including how the following affect the optics of the eye:
  - a. Low and high order aberrations
  - b. Corneal layers
  - c. Shape of cornea
  - d. Shape of lens
- Basic refraction techniques using trial lenses or phoropter for basic refractive errors, including:
  - a. Retinoscopy
  - b. Modification and refinement of subjective refraction
  - c. Cycloplegic retinoscopy and refraction
  - d. Postcycloplegic refraction
- Optical principles of common refractive surgery diagnostic tools, including:
  - a. Ultrasonic pachymetry
  - b. Keratometer
  - c. Lensometer
  - d. Pupillometry
  - e. Corneal topography
  - f. Scheimpflug imaging and elevation maps



- g. Optical coherence tomography (OCT)
- Topographic maps using different scales (i.e., absolute, normalised, adjustable):
  - a. Axial
  - b. Instantaneous
  - c. Refractive

**Clinical knowledge of ancillary testing:**

- Normal corneal topographic patterns, as well as topographic signs of keratoconus and ectasia.
- Elevation topography maps and their importance in screening refractive surgery candidates.
- Indications and limitations of corneal topography in refractive surgery.
- Mandatory diagnostic tests necessary for refractive surgery.
- Main IOL calculation formulas.
- Objective and subjective refraction, including cross-cylinder and Worth four-dot test.
- Diagnose refractive defects.
- Different prescription formulas.
- Ultrasonic pachymeter to measure corneal thickness.
- Corneal topography maps, including elevation topography. Recognise signs of ectatic disorders and/or candidates at risk for an unsatisfactory refractive surgery outcome, and rule out poor-quality tests (e.g., artifacts, alignment and corneal exposure issues).
- Aberration map and evaluate its significance in the refractive defect of a patient, as well as the need to treat or not.
- Tear film and tear deficiency.
- Astigmatism from higher order aberrations, such as coma.
- Basic diagnostic tools used in refractive surgery, including topography, pachymetry and biometry; and interpret results.
- Basics of wavefront analysis, including ray tracing and dynamic skiascopy, and graphical representation of wavefront errors, including corneal and entire eye high order aberration maps, point-spread function and modulation-transfer function.
- Basics of Zernike polynomials and Fourier analysis.
- Different topographic maps and scales for different purposes (e.g., screening, postoperative evaluation, detection of complications).
- Basics of measuring contrast sensitivity.
- Laser-tissue interaction and explain Munnerlyn formula.
- Refractive instruments and techniques (e.g., autorefractor, pachymetry, automated corneal topography, aberrometer, pupillometry, contact lens refraction, OCT, corneal hysteresis and corneal resistance factor) in the clinical setting for refractive surgery patients.
- Indications for and interpretation of preoperative and postoperative diagnostic testing, including:
  - a. Corneal topography
  - b. Wavefront analysis
  - c. Pachymetry
  - d. Calculation of stromal-bed thickness before and after LASIK
  - e. Aspheric profile of ablation
- Basics of modulation transfer function (MTF), point spread function (PSF) and Strehl ratio as objective ways to measure quality of vision.

- Basics of topography-guided, wavefront-guided and optimised ablations as compared to standard ablations.

#### Clinical knowledge of diagnosis and pathology:

- Basics of laser biophysics and laser tissue interaction.
- Complications of high myopia, high hyperopia and pathologies related to high astigmatism.
- Clinical stages of keratoconus and forme fruste keratoconus using clinical and topographic tests.
- Complex types of refractive errors, including postoperative refractive errors following cataract surgery, keratoplasty, refractive surgeries, ectatic conditions and irregular astigmatism.

#### Clinical knowledge of treatment:

- Milestones in refractive surgery development, including radial keratotomy, keratomileusis and phakic intraocular lenses (IOLs).
- Refractive surgery procedures, such as low myopia or low hyperopia with LASIK (microkeratome) and surface ablation (LASIK or photorefractive keratectomy [PRK])
- Current refractive procedures, their mechanisms of action, indications and limitations, including:
  - a. Types of excimer laser procedures
  - b. Phakic IOLs
  - c. Implantation of intracorneal ring segments
  - d. Corneal inlays
  - e. Accommodative lenses
- Principles and different types (i.e., linear, rotational, pendular) of mechanical microkeratomes, including their characteristics, indications, risks and possible complications.
- Role of femtosecond technology in refractive surgery, including advantages and limitations of flap creation with a femtosecond laser.
- Different techniques of keratoplasty and their relation with refractive surgery.
- Corneal biomechanics, including biomechanical responses to keratorefractive surgery, corneal healing after excimer laser procedures, corneal hysteresis and corneal resistance factor.
- Diagnose post laser in-situ keratomileusis (LASIK) ectasia and differentiate it from other conditions.
- Mechanism of action, indications, advantages and potential complications of mitomycin C application in surface ablation.
- Effect of corneal cross-linking on the biomechanical properties of the cornea, including its indications and how it can be combined with other refractive surgery procedures.
- Accommodative and non-accommodative treatments of presbyopia, including:
  - a. Monovision
  - b. Excimer laser correction
  - c. Conductive keratoplasty
  - d. Corneal inlays
  - e. Accommodating IOLs
  - f. Multifocal IOLs