

OPHTHALMOLOGY – (M.S.)

POST GRADUATE DEGREE STANDARD

1. Basic Science in Ophthalmology
2. Trauma and Emergency Ophthalmology
3. Disorders of the lids, lacrimal drainage apparatus, orbit and oculoplasty
4. External eye disease, sclera, cornea
5. Optics and refraction, contact lenses and low visual aids
6. Lens and Glaucoma
7. Uvea and Vitreo retinal diseases
8. Disorders of the optic nerve, visual pathway Neurophthalmology
9. Ocular motility, strabismus, paediatric ophthalmology.
10. Community Ophthalmology.

1. Basic Science in Ophthalmology
- #### **ANATOMY**

The Orbit and adnexa

Osteology

Eyelids

Conjunctiva

Lacrimal gland and accessory glands, and lacrimal drainage system

Extraocular muscles (including stability and movement of eyeball)

Intraorbital nerves, vessels and vascular supply, and orbital fat and fascia

Ocular anatomy

Including detailed topographical and microscopic anatomy of ocular structures, including blood supply, particularly with respect to function and relevance to clinical disease states.

Conjunctiva

Cornea

Sclera

Limbus and aqueous outflow pathways

Iris and pupil

Lens and zonular apparatus

Ciliary body

Choroid

Retina and retinal pigment epithelium and associated structures

Vitreous

Optic nerve

The Cranial cavity

Osteology of the skull

Meninges, blood supply, nerve supply

Venous sinuses

Foramina and their contents

Cranial fossae

Pituitary gland and its relations

Trigeminal ganglion

Central nervous system

Cerebral hemispheres and cerebellum

Surface appearance

Internal structure

Cortical areas

Ventricles

Formation and circulation of cerebrospinal fluid

Blood supply and venous drainage

Microscopic anatomy

Brain stem

Midbrain

Pons

Medulla and fourth ventricle

Nuclei of cranial nerves

Cranial nerves

Origin, course and distribution

Spinal canal

including spinal cord, venous plexus, meninges, and subarachnoid space

Specialised anatomy of visual system

Visual pathways – visual cortex, cortical connections and associated areas

Structures involved in control of eye movements

Autonomic nervous system and the eye.

Head and neck anatomy

Special areas to be covered include:

Nose, mouth and paranasal air sinuses

Lateral wall of nose, septum, vessels and nerves, osteology, anatomy, relations and development of air sinuses

The face and scalp

Muscles, nerves and vessels, temporal fossa, zygomatic arch, salivary glands and temporomandibular joint

The infratemporal fossa and pterygopalatine fossa

Muscles, vessels, nerves, carotid sheath, pterygopalatine ganglion

General topography of the neck

Posterior triangle, anterior triangle, suprahyoid region, prevertebral region, root of the neck

Respiratory system

The anatomy of the mouth, pharynx, soft palate and larynx with particular reference to bulbar palsies and tracheostomy

Lymphatic drainage of the head and neck

Including face

Ocular Physiology

Biochemistry of tears, aqueous and vitreous humor

Physiology and biochemistry of cornea

Lacrimal system

Lens metabolism

Retina photoreceptors, including vitamin A metabolism and phototransduction

Retinal pigment epithelium

Choroid

Blood-ocular barrier

Physiology of vision

- Visual acuity
- Accommodation
- Pupillary reflexes
- Light detection and dark adaptation
- Colour vision
- Electrophysiology of the visual system

Visual fields and visual pathways (including retinotopic organization)

- Processing of light stimuli
- Contrast sensitivity
- Eye movements
- Stereopsis
- Motion detection
- Visual perception

GENETICS

- Chromosomes and cell division
- Methods of genetic analysis
- Mendelian inheritance
- X-linked inheritance
- Mitochondrial inheritance
- Linkage analysis and disequilibrium and population genetics
- Chromosome mapping
- Gene mutations
- Oncogenes, and genetics of malignancy (including retinoblastoma)
- Inherited ocular disease : including for example retinitis pigmentosa, aniridia, choroidaemia, stationary night blindness, Norrie's disease
- Genetics of ocular disorders and of general conditions which contain an ocular component
- Principles of gene therapy

MOLECULAR AND CELL BIOLOGY

- Cell organelles, receptors and receptor signaling
- Plasma membrane
- Cytoskeleton and its relation to cell motility and contractility
- Nucleus
- Cell-cell communication
- Protein synthesis – pre – and post-transcriptional and translational control
- Molecular biology of protein synthesis

RECEPTOR PHYSIOLOGY

- Secondary messengers and intracellular signaling
- Understanding of molecular biological techniques (also in relation to genetics)
including: Polymerase chain reaction
- Northern and Southern Blotting
- In situ hybridization
- Extracellular matrix (particularly with respect to ocular structures)

Collagen synthesis – types and function
Proteoglycans, glycoproteins, fibronectin, laminin and glycosaminoglycans

Retinal neurochemistry

PHARMACOLOGY

Pharmacokinetics and pharmacodynamics
Drug receptor and secondary messengers : cellular mechanisms of drug action
Methods of drug delivery for ophthalmic agents, pharmacokinetics of individual

Methods

Pharmacology of:

Cholinergic and adrenergic systems
Drug control of intraocular pressure
Serotonin
Histamine
Anti-inflammatory agents
Anti-infective agents
Immunosuppressants
Local anaesthetics
Analgesics
Mechanisms of drug toxicity and drugs which specifically cause ocular toxicity

MICROBIOLOGY

Principles of Infection

Culture media

Bacteria

Gram staining and classification
Exo and endotoxins
Mechanisms of virulence and pathogenicity
Synergic infections
Antibiotics : including mechanisms of action, bacterial resistance
Host defence mechanisms against bacterial infection, with particular reference to ocular defence
Commensal eye flora

Viruses

Classifications
Structure and replication
Host defence against viral infection
Antiviral agents
Specific antiviral agents: mechanisms of action
Laboratory methods for viral detection
Viral infections of the eye

HIV AND AIDS

Classification, diagnosis, laboratory diagnosis and monitoring of HIV infection

Neuro-ophthalmic opportunistic infections

Anti HIV agents

Fungi

Classification: Ocular fungal infections

Host factors which predispose to fungal infection

Antifungal agents

Others

Toxoplasmosis

Chlamydia

Acanthamoeba

Helminthic infections

Antimicrobials

PATHOLOGY

CLINICAL FEATURES AND MANAGEMENT OF:

Eyelid tumours

Tumours of conjunctiva and cornea

Uveal tumours

Retinoblastoma (including genetics)

Metastatic disease to the eye and orbit

Orbital tumours in children and adults

Cornea

Inflammation, including graft rejection, dystrophies and degenerations

Lens

Cataract formation

Uvea

Inflammation

Vascular disease

Infection

Tumours

Retina

Vascular disease

Degenerative disease

Dystrophies
Detachment
Infection
Tumours

Optic nerve

Vascular disease
Toxic
Inflammatory and neoplastic disease

Phacomatoses

Glaucoma

Orbit

Inflammations
Tumours

Pathological findings in the eye and orbit in systemic disease

Diabetes
Thyroid disease
Vascular disease

Pathology of infectious disease

Cornea
Intraocular
Orbital
Intracranial

Vitamin metabolism and deficiency states

IMMUNOLOGY

Innate and acquired immunity
Effector mechanisms of immune response
Humoral immunity and antibody class and function
Cellular immunity
Immunity against microbes (see microbiology)
T and B Cells : cluster differentiation, phenotype, T and B cell activation
MHC antigens, antigen presenting cells and antigen processing
Immune mechanisms of tissue damage
Interleukins, complement
Immunodeficiency (see microbiology) and immunosuppression (see pharmacology)
Organ transplantation and pathophysiology of allograft rejection

OPTICS AND REFRACTION

PHYSICAL OPTICS

Properties of light

Visible light and its place in the electromagnetic spectrum
Wavelength and frequency
Propagation of light
Wave and particle theory
Fluorescence and phosphorescence
Absorption and transmission of electromagnetic radiation by the eye
Ophthalmic hazards of different electromagnetic radiations
Diffraction, Interference, Polarization, Transmission and Absorption
Laser Theory
History and development of lasers
Properties of laser light
Coherence
Solid crystal lasers
Gas discharge tube lasers
Dye lasers
Q switching
Pulsed and continuous wave lasers
Laser hazards and safety

GEOMETRIC OPTICS

Basics

Reflection at plane and curved surfaces, the images produced and their character including ray diagrams
Refraction
Refractive index
Critical angle
Total internal reflection
Prisms (including Fresnels), power and notation
Lenses
Spherical lenses
Cardinal points, axes and principal ray diagrams
Character of images produced
Power and notation of lenses
Magnification
Thin and thick lenses and their formulae
Prismatic effect of decentring lenses
Principles of the pin hole
Principles of the stenopaeic slit
Aspheric lenses and their use in ophthalmology
Cylindrical lenses and their focal characteristics
Maddox rod
Jackson's cross cylinder
Astigmatic lenses
Conoid of Sturm
Circle of least confusion
Confocal optics

CLINICAL OPTICS

Basics

Optics of the normal eye including accommodation, accommodative reserve, near synkinesis and the changes in accommodative reserve with time

The schematic and reduced eye
Refractive indices of ophthalmic media including the tear film
The effect of pupil diameter
Use of the pinhole
Visual acuity
Snellen and Log MAR theory
Contrast sensitivity gratings and the Peli-Robson Test

Refractive error and its correction

Emmetropia
Myopia and hypermetropia:
Prevalence, inheritance, aetiology and associations
Astigmatism:
Regular and irregular astigmatism and principles of its correction
Pinhole, stenopaeic slit and contact lens in its investigation
Keratoscopic patterns in regular and irregular astigmatism
Accommodative reserve and its variation with age
Presbyopia
Aphakia
Pseudophakia

Clinical refraction

Retinoscopy including recognition of abnormal retinoscopy reflexes
Retinoscopy and prescribing in children
Cycloplegic agents, their effects and hazards
Subjective refraction
Pinhole and Duochrome test
Interpupillary distance and back vertex distance
Decentring of lenses
Anisometropia and aniseikonia and the practical limits for spectacles
Prescribing for presbyopia
Muscle balance tests

Spectacle lenses

Spectacle lenses and their notation
Transposition
Spherical equivalent
Identification of unknown lenses
Recognition of plus and minus lenses clinically
Detection of prisms
Neutralisation and focimetry
Use of the Geneva lens measure and its limitations
Aberrations of lenses and their minimization
Bifocal, multifocal and varifocal lenses
Best form lenses

Contact lenses

Classification
Materials
Advantages over spectacles (especially for high ametropia)

Optical principles of refractive surgery

Radial keratotomy

Surface laser

LASIK

Principles of intracorneal rings

Phakic intraocular lenses

Clear lens extraction

Correction of high ametropia

Optical advantages and disadvantages of different methods

The candidates should have a detailed knowledge of:

Direct and indirect ophthalmoscope

Retinoscope

Slit-lamp biomicroscope

Applanation tonometer

Operating microscope

Focimeter

The candidate should be familiar with the optical principles of:

Slit-lamp diagnostic and therapeutic lenses

Simple magnifiers

Telescopic low visual aids

Lensmeter

Autorefractors

Keratometer

Endothelial specular microscope and confocal microscopy

Placido's disc and keratoscope

Optical pachymetry

Placido and elevation computerized corneal topography

Zoom lenses

Lee screen / Hess chart

Synoptophore

Fundus and slit-lamp cameras

Scanning laser ophthalmoscope

EXTERNAL EYE AND CORNEA

Eyelid

General and dermatological problems and eyelid margin disease, including meibomian gland dysfunction

Dry eye – causes, symptoms and management

2. Trauma and Emergency Ophthalmology

Essential topics/experience

To have become familiar with the following:

- Superficial ocular trauma: including assessment and treatment of foreign bodies, abrasions and minor lid lacerations
- Severe blunt ocular injury: management of hyphaema - recognition and initial management of more severe injury.
- Severe orbital injury: recognition and initial care of corneal and scleral wounds; recognition of aqueous leakage and tissue prolapse.

- Retained intraocular foreign body; anticipation from history, confirmation of X-ray and CT Scan.
- Sudden painless loss of vision; recognition of retinal arterial occlusion, central retinal vein occlusion, acute ischaemic optic neuropathy, optic neuritis, urgency of treatment.
- Severe intraocular infection; recognition and initial investigation and management of hypopyon.
- Acute angle closure glaucoma; recognition and acute reduction of intraocular pressure.
- Liaison with Radiological department, Microbiologist, ENT and Faciomaxillary surgeons.

Practical Skills

- à Removal of superficial foreign bodies
- à Corneal epithelial debridement
- à Repair of minor conjunctival/lid laceration
- à YAG iridotomy

- Eye protection and prevention of injury
- Lateral canthotomy and inferior cantholysis for retrobulbar haemorrhage
- Chemical/alkali burns of the conjunctiva and cornea
- Drug penetration into the eye and vitreous
- Use of intravitreal antibiotics, including dosage and potential complications.

3. Disorders of the lids, lacrimal drainage apparatus, orbit and oculoplasty

Essential experience

- Abnormal lid position; including assessment of ectropion, entropion, ptosis, trichiasis, lagophthalmos and exposure.
- Abnormal lid swelling, including chalazion, stye, retention cysts, papilloma and basal cell carcinoma.
- The watering eye, including the distinction between excessive lacrimation and epiphora, blepharitis, recognition and investigation of nasolacrimal obstruction.
- Orbital swelling, including dysthyroid eye disease, distinguishing intraconal from extraconal space-occupying lesions, orbital cellulitis, recognition of compressive optic neuropathy.
- Liaison with Neurosurgeons, ENT, Endocrinologists and orbit reconstruction Services.

Practical Skills

- Use of exophthalmometer
- Syringing and probing
- Incision and curettage for chalazion
- Wedge biopsy and removal of papilloma, etc.
- Tarsorrhaphy
- Electrolysis/cryotherapy for trichiasis
- Surgery to involutinal ectropion/entropion

Background theory/principles

To have gained an awareness of the following:

- Sebaceous carcinoma of lid and squamous cell carcinoma
- Cicatricial malposition of the lids
- Management of ptosis and blepharospasm
- Canaliculus repair
- Dacryocystorhinostomy
- Orbital and lacrimal tumours and their treatment

- Inflammatory orbital and lacrimal diseases and their treatment
- Paranasal sinus disease
- Use of radiographs, MRI, CT scan
- Enucleation, evisceration and fitting of prosthesis
- Exenteration

4. External eye disease, sclera, cornea and anterior area

Essential experience

- Infectious external disease, including viral, bacterial and chlamydial conjunctivitis.
- The dry eye, including symptoms, assessment of reduced tear production and tear film stability and treatment.
- Allergic and atopic eye disease recognition and management.
- Corneal ulceration from viral and bacterial disease, marginal keratitis.
- Complications of contact lens wear.
- Corneal oedema, opacity and ectasia, indications for corneal transplantation, standards of care in donor eye procurement, signs of corneal graft rejection and other complications.
- Epitheliitis, recognition and management.
- Anterior uveitis, including classification, differential diagnosis, systemic associations, investigations and treatment.
- Liaison with microbiology, immunology.

Practical skills

- Conjunctival sampling and corneal scraping for microbiological investigations.
- Pachometry for corneal thickness.
- Keratometry and Placido's disc.
- Removal of corneal sutures.
- Retrieval of donor eyes for transplantation (5)

Background theory/principles

Acanthamoeba keratitis and fungal keratitis

- Cicatricial conjunctival disease.
- Punctal occlusion
- Corneal topography and specular microscopy
- Corneal stromal dystrophies, interstitial keratitis.
- Corneal biopsy, indications.
- Chemical injury of the cornea and conjunctiva.
- Therapeutic contact lenses and their complications.
- Corneal transplantation, immunology of rejection.
- Limbal stem cell transplantation.
- Autoimmune corneal and scleral disease including peripheral ulcerative keratitis.
- Use of immunosuppressive therapies.
- Management of pterygium.
- Conjunctival and uveal tumours.
- Aniridia and other dysgenesis.
- Fuch's heterochromic cyclitis.

5. Optics and refraction, contact lens and low vision aids

- Ametropia, including hypermetropia, myopia, astigmatism and their complications.
- Accommodation problems, including spasm and presbyopia.
- Knowledge of contact lens fitting, indications, management and complications.
- Low vision aids services and rehabilitation of a low vision patient.

Practical Skills

To have undertaken (under supervision until proficient) the following:

- Retinoscopy with trial lenses and subjective refraction.
- Correction of refractive error by spherical, cylindrical and multi-focal lenses.
- Lens neutralisation and use of focimeter.

Background theory/principles

To have gained an awareness of the following:

- Basis of spectacle intolerance from poor dispensing or defective prescription.
- Use of log MAR charts in assessment of acuity.
- Alternatives to capsular IOL fixation.
- Combined cataract and glaucoma/corneal transplantation surgery.
- Ectropia lentis and Marfan's syndrome.
- Contact lenses and refractive surgery.
- Therapeutic contact lenses.
- Fluidics and ultrasonics.
- Intraocular lens design and biomaterials.

6. Disorders of lens and glaucoma

Essential topics/experience

To have become familiar with the following:

- Lens opacifications, including types of cataract, relationship of opacity to symptoms, contribution to visual loss in co-morbidities, systemic associations, cataract surgery and its complications.
- Pseudoexfoliation of the lens capsule, including its recognition and significance.
- Calculation of intraocular lens power, according to the patient's needs.
- Glaucomatous optic neuropathy, recognition and investigation.
- Glaucoma suspects, including ocular hypertension.
- Rubeotic glaucoma recognition, differential diagnosis and management.
- Hypotensive agents, topical and systemic drugs affecting intraocular pressure and their complications.
- Glaucoma drainage surgery, indications, complications and their treatment.
- Hypotony, including its causes and consequences.

Practical Skills

To have undertaken (under supervision until proficient) the following:

- Applanation tonometry
 - Assessment of peripheral and central anterior chamber depth, including pachymetry.
 - Assessment of irido-corneal angle structures by gonioscopy.
 - Methods of optic disc cup measurement.
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- Visual field testing, including Goldmann/kinetic perimetry and automated static perimetry.

Background theory/principles

To have gained an awareness of the following:

- Risk factors for primary open-angle and normal-tension glaucoma
- Other secondary glaucomas, including phacolytic, pigmentary, erythroclastic, pseudo-exfoliative and silicone-oil glaucomas.
- Posner Schlossman syndrome.
- Chronic closed angle glaucoma.
- Malignant glaucoma
- Tonopen, Perkins and non-contact tonometry.
- Scanning laser ophthalmoscopy and nerve fibre layer analysis
- Argon laser trabeculoplasty
- Prevention of glaucoma bleb failure e.g. using anti-metabolites
- Drainage tubes and stents.
- Cycloablation.

7. Vitreoretinal disorders

Essential topics/experience

To have become familiar with the following:

- Diagnosis and management of anterior, intermediate and posterior uveitis
- Flashes and floaters, complications of posterior vitreous detachment and recognition of retinal tears.
- Vitreous haemorrhage, from retinal tears or neovascularization - initial management.
- Retinal detachment, classification, predisposition, recognition and urgency of treatment, recognition of proliferative vitreoretinopathy.
- Diabetic retinopathy, classification, screening strategies, management.
- Hypertensive and arteriosclerotic retinopathy, including macroaneurysms and branch retinal vein occlusion.
- Retinal vascular occlusions, recognition of ischaemic and exudative responses, rubeosis.
- Macular diseases, including recognition of age – related maculopathy, subretinal neovascularization, cystoid macular oedema, macular hole, related symptomatology and urgency of treatment.
- Fluorescein angiography, indications, complications and interpretation.

Practical Skills

To have undertaken the following:

Slit lamp examination and the use of various contact and non contact fundus lenses

- Scleral indentation with indirect ophthalmoscopy.
- Retinal drawing
- Cryopexy and laser (via slit-lamp and indirect ophthalmoscope delivery systems) for retinal tear.

Background Theory/Principles

To have gained an awareness of the following:

- B-Scan ultrasound for opaque media.
- Vitreoretinal surgery, including closed intraocular microsurgery, scleral buckling and internal tamponade.
- Intraocular foreign body, complications and management.
- Other vasoproliferative vitreoretinopathies including sickle cell retinopathy, retinopathy of prematurity,

Eales' disease.

- Genetic vitreoretinal disease-Stickler syndrome, X-linked retinoschisis.
- Asteroid hyalosis
- choroido-retinal coloboma

Background Theory/Principles

To have gained awareness of the following:

- fundus imaging including scanning laser ophthalmoscopy.
- Indocyanine green angiography.
- Electro diagnostic tests and dark adaptation.
- Genetic retinal disease, retinal dystrophies, retinoblastoma.
- differential diagnosis and treatment of malignant melanoma.
- Macular laser photocoagulation, principles and laser safety.
- Toxic maculopathy and central serous retinopathy.
- Intraocular lymphoma.
- Intermediate and posterior uveitis, toxoplasmosis, toxocara and sympathetic ophthalmia, retinal vasculitides.
- Coats' disease, other telangiectasias and the retinal phakomatoses.
- AIDS-related opportunistic infections and anti-AIDS treatment

8. Disorders of the optic nerve and visual pathways-Neurophthalmology

Essential topics/experience

To have become familiar with the following:

- Swollen optic disc, differential diagnosis, recognition and evaluation of papilloedema, ischaemic optic neuropathy (arteritic and non-arteritic), acute optic neuritis and congenital optic disc anomalies.
- The atrophic optic disc, recognition and differential diagnosis, clinical evaluation of optic nerve function.
- Visual pathway disorders, identification of site and nature of lesion from history, examination and investigations, transient ischaemic attacks.
- Examination of cranial nerve palsies particularly III, IV, VI, VII and V nerve

Practical Skills

To have undertaken (under supervision until proficient) the following:

- Goldmann visual fields
- Examination of the cranial nerves
- Temporal artery biopsy

Background theory/principles

To have gained an awareness of the following:

- Benign intracranial hypertension
- Compressive optic neuropathy
- Optic nerve glioma
- Chiasmal lesions
- Visual evoked responses

- Neuro-imaging including CT, MRI and carotid doppler
- Carotid endarterectomy
- Multiple sclerosis and its ophthalmic manifestations
- Higher cortical dysfunction, including the visual agnosias.

9. Strabismus and paediatric Ophthalmology

Essential Topics/experience

To have become familiar with the following:

- Concomitant strabismus, screening strategies, epicanthus, accommodative aspects, interpretations of orthoptic report, indications for surgery.
- amblyopia, anisometropic, stimulus-deprivation, strabismic prevention and treatment using occlusions.
- Incomitant strabismus, cranial nerve palsies including diabetic mononeuropathies, significance of painful third nerve palsy and of pupil sparing, prediction of post operative diplopia.
- the approach to infants, children and their parents.
- Ophthalmia neonatorum, diagnosis and management.
- Congenital nasolacrimal obstruction; recognition and management
- Ametropia in children, significance and treatment
- The apparently blind infant, normal and delayed visual maturation
- Paediatric cataract surgery and paediatric glaucoma.

Practical Skills

To have undertaken (under supervision until proficient) the following:

- Eye movement evaluations
- Cover test (including alternate and prism)
- Stereo tests
- Cycloplegic refraction
- Horizontal muscle surgery
- Synoptophore examination

Background theory/ Principles

To have gained an awareness of the following:

- Nystagmus
 - Ocular motility syndromes (duane's, brown's)
 - Use of botulinum toxin
 - Ocular myopathies and the neuromuscular junction
 - Supranuclear eye movement disorders
 - Fresnel prisms
 - Oblique muscle, vertical muscle and adjustable suture surgery
 - Electromyography.
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- Assessment of vision in children, fixation, preferential looking, single and linear optotype tests.
 - Cycloplegic refraction and prescribing for children.
 - Fundoscopy in children.
 - Ocular albinism Congenital nystagmus
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- Congenital glaucoma, diagnosis and management.
 - Congenital cataract, diagnosis and management including prevention of amblyopia.
 - Leucocoria, differential diagnosis including retinoblastoma.
 - Retinopathy of prematurity, screening and treatment.
 - Paediatric neurological diseases.
 - Ophthalmic signs of child abuse
 - Orbital Cellulitis presenting in children.
 - Orbital tumours in children, including rhabdomyosarcoma.

10. Community Ophthalmology.