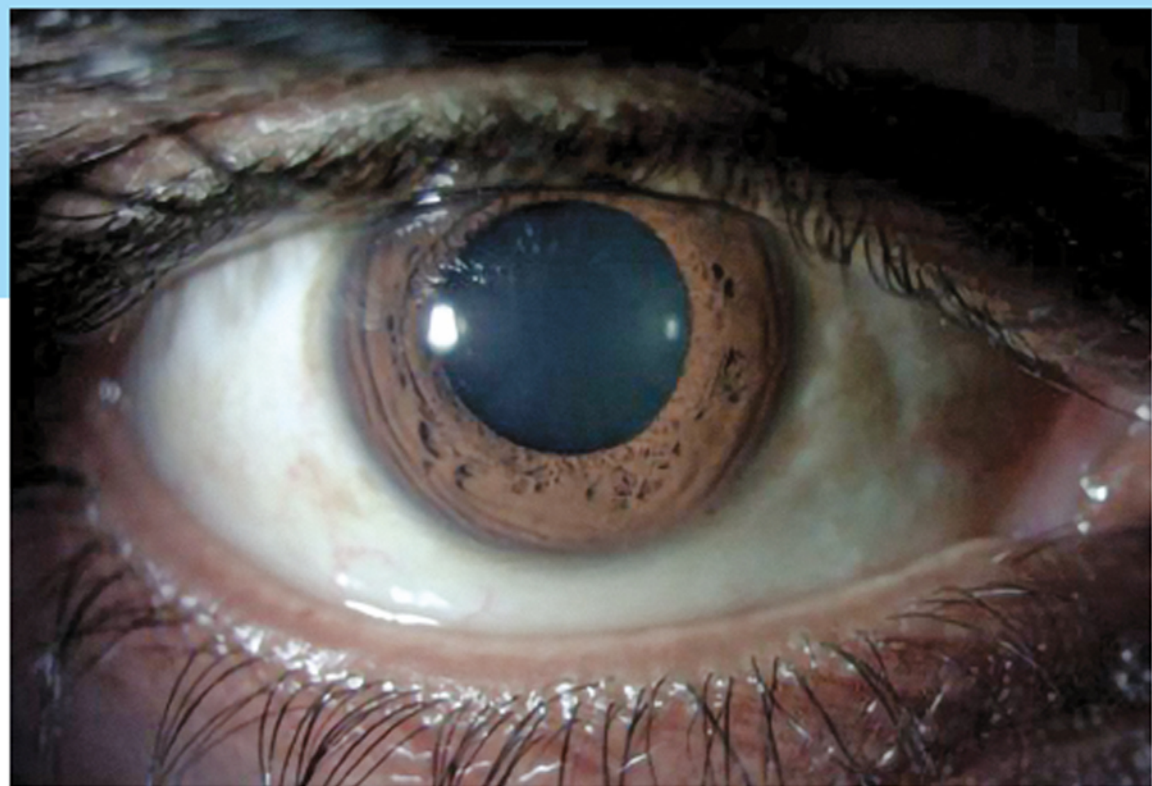


Textbook of Ophthalmology

Sanjeev Kumar Mittal
Raj Kumar Agarwal

Second Edition



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Textbook of Ophthalmology

Second Edition

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*Dedicated to
The Almighty*

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Foreword

It is my pleasure to write a foreword for *Textbook of Ophthalmology, Second Edition* by Dr. Sanjeev Kumar Mittal and Dr. Raj Kumar Agarwal. This book comprehensively covers all the aspects that are required for undergraduate and postgraduate students in a manner that exemplifies an ideal resource for learning. The initial segments are dedicated toward simplifying basic ocular anatomy, physiology, as well as optics and refraction. The subsequent chapters cover the clinical aspects of various parts of the eye, right from the lid and adnexa to the optic nerve and visual pathways. The highlight of the book is the emphasis on management of common ocular diseases and disorders. In addition, the authors have provided inputs for common ocular surgeries and the various advancements in the field of diagnostics and their management. The book leaves no stone unturned by not only covering the ocular manifestations of systemic diseases with emphasis on neurological disorders but also incorporating a chapter on community ophthalmology, which should be an integral part of the subject. I congratulate the authors for encapsulating these various aspects in this easy-to-read book. I am confident that the readers will find this book a valuable companion throughout their studies and a stepping stone toward becoming a competent ophthalmologist.

Jeewan S. Titiyal, MD, DSc, FRCOphth

Professor of Ophthalmology

Chief, Dr R. P. Centre for Ophthalmic Sciences

All India Institute for Medical Sciences, New Delhi

Foreword

It is indeed an honor and privilege to introduce the much-awaited second edition of *Textbook of Ophthalmology*, authored by Dr. Sanjeev Kumar Mittal and Dr. Raj Kumar Agarwal, a comprehensive resource curated to empower students, clinicians, and academicians in the domain of ophthalmology.

The second edition further builds upon the solid foundation of its predecessor, incorporating the latest advancements, clinical practices, and research developments in the dynamic field of ophthalmology. With the rapid evolution of medical technology and techniques, this edition serves as an indispensable guide for fine tuning higher understanding and developing confidence in managing ophthalmic disorders with clarity and precision.

The authors bring to this book a wealth of knowledge and decades of experience as educators and ophthalmic practitioners. Their ability to distil complex concepts into a structured and simplified format is evident throughout the text. Detailed anatomical illustrations and updated guidelines on diagnostics and therapeutics have been provided and the book strikes an ideal balance between comprehensive knowledge and practical skill.

This edition is enhanced with new chapters, updated algorithms, and case-based discussions that cater not only to undergraduate and postgraduate students, but also to practicing ophthalmologists. Additionally, the inclusion of recent advances ensures that readers are well-equipped to meet the challenges of modern ophthalmic care.

I commend the authors for their dedication to excellence and for their effort in making the knowledge of ophthalmology accessible and applicable in daily practice, contributing substantially to the ongoing advancement of medical education.

I am confident that this second edition will continue to serve as a valuable resource for aspiring and established ophthalmologists alike, fostering deeper learning and improved patient outcomes.

With great respect and admiration,

Radhika Tandon, MD, DNB, FRCSEd, FRCOphth, FNAMS, FNASI

Professor of Ophthalmology

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Preface to the Second Edition

It was a thrilling and satisfying feeling for us when the publishers approached us for a second edition of this book. We received considerable feedback from UG and PG students and ophthalmic faculty across the nation through the publisher and directly to us as well.

The second edition in general has been updated keeping in view the advancements in diagnostics and treatment. The chapters on Optics—Refraction, Symptomatology—Examination, Cornea, Conjunctiva, Pupil, Lens, Retina, Ocular Tumors, Injuries, Systemic Diseases, and Surgery and Community Ophthalmology have undergone major changes. We have maintained the pattern by using simple language, tables, and flow diagrams. Clinical vignettes are also added at the end of each chapter. The Competency Mapping Chart is also revised as per the latest NMC notification dated September 12, 2024. A link of videos for various procedures as per the revised competency-based curriculum is also included.

We have tried our best to make the second edition an essential tool for MBBS students, those preparing for PG entrance examination, ophthalmic faculty, and practicing ophthalmologists as well as a foundation book for postgraduate residents.

Sanjeev Kumar Mittal, MS, FICO, MAMS
Raj Kumar Agarwal, MS

Preface to the First Edition

The goal of this book is to provide a clinical overview of the major areas of ophthalmology in a simplified way. Although this book is essentially meant for undergraduate students, it will not only be of great use for postgraduation aspirants but also serve as a foundation book for residents in ophthalmology.

To make it more student friendly, illustrations, tables, and flow charts have been generously used to give it the form of a conceptual book.

We had started working on this book about 8 years ago. Now, we are happy to complete this and bring it to our readers. In fact, some part of the text is in more detail than required, but this feature of the book makes the text more attractive and explanatory in nature. The undergraduate course is not as extensive as the one earmarked for postgraduate entrance examinations. The contents of this book, however, cover the latter requirement. MBBS students should keep this fact in mind. Nevertheless, in spite of our efforts, the book is not likely to be free from human errors and mistakes. Therefore, any feedback and suggestions from the readers will be appreciated.

Sanjeev Kumar Mittal, MS, FICO, MAMS

Raj Kumar Agarwal, MS

(2020)

Acknowledgments

With blessings of my parents, I, Dr. Sanjeev Kumar Mittal, acknowledge the motivation provided by my spouse Dr. Sunita Mittal and daughters Dr. Gauri Mittal and Pooja Mittal in writing this textbook of ophthalmology.

This book owes its existence to the help, support, and inspiration of several people as well as the blessings of my parents. I, Dr. Raj Kumar Agarwal, would like to express my sincere gratitude toward my spouse Dr. Renu Agarwal and daughters Dr. Akshi Raj and Dr. Archi Raj in writing the book of ophthalmology.

We extend our heartiest appreciation to our alma mater where we built a passion for teaching and writing. The students, too, have proved to be a perennial source of inspiration.

The contributions of the entire publication team at Thieme and Ms. Yukti Tyagi toward compiling the manuscript are priceless.

Sanjeev Kumar Mittal, MS, FICO, MAMS
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Competency Mapping Chart

Competency Code	Competency	Chapter No.	Page No.	Video
Topic 1: Visual Acuity Assessment				
OP1.1	Describe the physiology of vision, optics of eye, and anatomy of visual pathway	2 3 16	16 44 510	
OP1.2	Define, classify, and describe the types and methods of correcting refractive errors	3 5	51 111	Video 3.1 (p. 51)
OP1.3	Demonstrate the steps in performing the visual acuity assessment for distance vision, near vision, color vision, the pinhole test, and the menace and blink reflexes	2 5	23, 25, 26, 31 115	Video 2.1 (p. 23)
OP1.4	Enumerate the indications and describe the principles of refractive surgery	3 26 27	65 805 826	
OP1.5	Define amblyopia, enumerate the types of amblyopia, and describe the prevention and treatment of refractive amblyopia	18	561	
Topic 2: Lids and Adnexa, Orbit				
OP2.1	Describe and discuss the etiology and clinical features, investigations, and treatment of hordeolum externum, hordeolum internum, ectropion, entropion, lagophthalmos, blepharitis, and preseptal cellulitis	21 23 27	651, 654, 655, 666, 668, 673 711 806, 808	
OP2.2	Demonstrate under supervision, the clinical procedure performed—Bell's phenomenon, ptosis evaluation, epilation; massage technique in congenital dacryocystitis	21 27 22	658, 662, 656 810 686	
OP2.3	Describe the etiology, clinical presentation, complications, and management of thyroid eye disease	23	717	
OP2.4	Describe the etiology and clinical presentation, discuss the complications and management of orbital cellulitis	23	711	
OP2.5	Describe the clinical features on ocular examination and management of a patient with cavernous sinus thrombosis	23	715	
OP2.6	Enumerate the causes and describe the differentiating features and clinical features and management of proptosis	23	706	
OP2.7	Classification and clinical presentation of various types of orbital tumors	19	586	
OP2.8	Describe the investigations, management, and indications for referral of orbital tumors	23 19	705 586	
Topic 3: Conjunctiva				
OP3.1	Demonstrate history taking in a patient with “red eye,” enumerate the causes for red eye	5 6 9	97 127, 128 240	
OP3.2	Describe the etiopathogenesis, clinical features, and treatment of acute bacterial and viral conjunctivitis	6	130, 135	

Competency Mapping Chart

Competency Code	Competency	Chapter No.	Page No.	Video
OP3.3	Enumerate the causes for chronic conjunctivitis Describe the etiology, pathophysiology, ocular features, differential diagnosis, complications, and management of trachoma	6	133, 139	
OP3.4	Enumerate the causes for allergic conjunctivitis; describe the etiology, pathophysiology, ocular features, complications, and management of vernal catarrh	6	145, 149	
OP3.5	Describe the etiology, pathophysiology, ocular features, differential diagnosis, complications, and management of pterygium	6	156	
OP3.6	Demonstrate correct technique of removal of foreign body from the eye in a simulated environment	20	623	Video 20.1 (p. 623)
OP3.7	Demonstrate under supervision the technique of instillation of eye drops and counseling of patients you put on topical ocular medications	4	69	Video 4.1 (p. 69)
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OP4.1	Describe the applied anatomy and physiology of cornea and the factors maintaining corneal transparency	7	161, 165	
OP4.2	Enumerate various congenital anomalies and inflammations of cornea	7	202, 207 172	
OP4.3	Enumerate the differential diagnosis of corneal ulcer (infective keratitis) and describe the etiopathogenesis, clinical features, and management of each type of infective keratitis	7	172	Video 7.1 (p. 172)
OP4.4	Identify corneal opacity and different grades of corneal opacity; enumerate various management modalities of corneal opacity	7	166	
OP4.5	Describe tear film; enumerate the causes of dry eyes and describe the clinical features and management of dry eyes	22	680, 692	Video 22.2 (p. 694)
OP4.6	Define blindness; enumerate the causes of corneal blindness	28	859, 865	
OP4.7	Enumerate the types and the indications of keratoplasty	27	823	
OP4.8	Describe the importance of eye donation and eye banking and enumerate the various protocols involved in eye donation and eye banking	27	825	
OP4.9	Identify corneal foreign body and demonstrate techniques of removal of corneal foreign body in simulated environment	20	623	Video 20.2 (p. 623)
OP4.10	Counsel patients and family in a simulated environment about eye donation and teach them how to preserve the eye in the deceased till enucleation is done	27	825	Video 27.2 (p. 825)
Topic 5: Sclera				
OP5.1	Describe the etiopathogenesis, classification, clinical features, complications, and management of episcleritis	8	214	
OP5.2	Enumerate the systemic conditions associated with episcleritis and scleritis, and indications for their referral	8	214, 216	

Competency Code	Competency	Chapter No.	Page No.	Video
Topic 6: Iris and Anterior Chamber				
OP6.1	Define uveitis; describe the anatomical classification of uveitis; describe the clinical features of iridocyclitis; distinguish granulomatous iridocyclitis from non-granulomatous iridocyclitis	9 5 20	229, 231, 232 108 636	
OP6.2	Describe the complication of iridocyclitis, and investigations and treatment of iridocyclitis	9	232, 239, 242	
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OP7.2	Describe the etiopathogenesis, clinical features, and management of primary open angle glaucoma	12 27	363 847	Video 12.1 (p. 341), Video 12.2 (p. 342), Video 12.3 (p. 344)
OP7.3	Describe the etiopathogenesis, clinical features, and management of primary angle closure glaucoma	12 27	368 847	
OP7.4	Enumerate the causes of secondary glaucoma	12	373	
OP7.5	Counsel the patient with glaucoma regarding the treatment modalities, complications with treatment, and prognosis in a simulated environment	12	355	
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OP8.1	Describe the surgical anatomy of lens	11	289	
OP8.2	Describe the etiopathogenesis, etiological classification, stages of maturation, and complications of cataract	11 12	295, 299, 300, 301, 305, 311 375	
OP8.3	Demonstrate the preoperative evaluation and counseling of a patient posted for cataract surgery	11	295, 299, 300, 304, 305, 314, 316	
OP8.4	Enumerate the different types of cataract surgery; enumerate the different ocular anesthesia techniques; describe the steps of extracapsular cataract surgery, enumerate the intraoperative and postoperative complications of ECCE, discuss the postoperative treatment	11 27 12	319, 317, 833, 840 384	Video 11.1 (pp. 319 and 833), Video 11.2 (pp. 319 and 833), Video 11.3 (pp. 319 and 833), Video 11.4 (pp. 319 and 833)

Competency Mapping Chart

Competency Code	Competency	Chapter No.	Page No.	Video
OP8.5	Elicit history and clinical signs in a case of aphakia; discuss the management of aphakia	11	319	
OP8.6	Participation of IMG in the team for cataract surgery	–	–	–
Topic 9: Retina and Optic Nerve				
OP9.1	Demonstrate the technique of direct and indirect ophthalmoscopy; describe the fundoscopic features of normal retina	5 14	117, 110 407, 408	Video 5.1 (p. 118)
OP9.2	Describe the etiopathogenesis, clinical features, management, and screening protocol for diabetic retinopathy	14	428	
OP9.3	Discuss the etiopathogenesis, clinical features, and management of vascular occlusions of retina	14	421, 423	
OP9.4	Discuss the etiopathogenesis, clinical features, and management of hypertensive retinopathy, retinopathy of prematurity, Eales disease, retinal detachment, central serous retinopathy, cystoid macular edema, age-related macular degeneration, retinitis pigmentosa, and retinoblastoma	14 19	434, 436, 442, 447, 449, 454, 461, 469 610	
OP9.5	Describe and discuss the correlative anatomy, etiology, clinical manifestations, diagnostic tests, imaging, and treatment of diseases of the optic nerve and visual pathway	15 16	479, 480, 483 489, 498, 501, 510, 513	Video 10.1 (p. 275), Video 16.1 (p. 513)
Topic 10: Miscellaneous				
OP10.1	Demonstrate the correct technique to examine extraocular movements (uniocular and binocular)	17	530	Video 17.1 (p. 530)
OP10.2	Classify, enumerate the types, methods of diagnosis, and indications for referral in a patient with heterotropia/strabismus	18	544, 545, 546, 549, 554, 564	
OP10.3	Describe the role of refractive error correction in a patient with headache and enumerate the indications for referral	3 5 18 24	51, 63, 65 111 547 768	
OP10.4	Describe the classifications, causes, ocular manifestations, and management of vitamin A deficiency; indications for referral	25 28	792 864	
OP10.5	Enumerate the indications for enucleation, evisceration, and exenteration	27	853, 854, 855	
OP10.6	Classify ocular injuries, describe their primary management; indications for referral	20 21 23 12 14	619, 620, 623, 627, 635, 638 673 721 382 444	Video 20.1 (p. 623), Video 20.2 (p. 623)
OP10.7	Enumerate the causes of blindness and vision impairment; discuss National Program for Control of Blindness (NPCB, including Vision 2020)	28	860, 861, 862, 865	

1 Anatomy and Embryology of the Eye

Anatomy of Eyeball.....	1
Blood Supply of Eyeball.....	3
Innervation of Eyeball.....	5
Embryology of Eyeball.....	7

Anatomy of Eyeball

Each eyeball is situated in a bony cavity known as the orbit. It is protected by eyelids and soft tissues. In the orbit, it is suspended by extraocular muscles and their facial sheaths.

Dimensions

- Anteroposterior diameter: at birth—17.5 mm; in adults—24 mm.
- Horizontal diameter: 23.5 mm.
- Vertical diameter: 23 mm.

Shape

Being flattened in vertical diameter, its shape resembles an oblate spheroid.

Structure

Eyeball consists of three coats (tunics, **Fig. 1.1**):

1. Outer fibrous coat.
2. Intermediate vascular coat (uveal tissue).
3. Innermost nervous layer (retina).

Outer Fibrous Coat

It consists of cornea and sclera. Cornea is the anterior 1/6th, *transparent and avascular* part of the fibrous coat. Sclera is the posterior 5/6th opaque part of the fibrous coat. The anterior part of the sclera is covered by a mucous membrane, the conjunctiva, which is reflected over the inner surface of the eyelids. The junction of sclera and cornea is called the *sclerocorneal junction* or limbus. Conjunctiva is firmly adherent at the limbus.

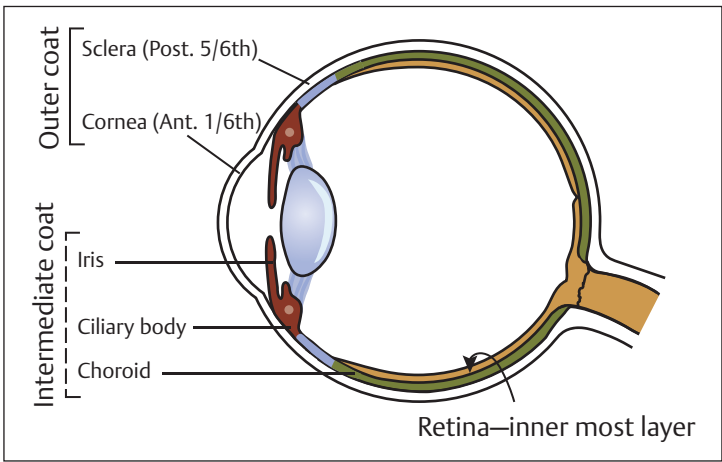


Fig. 1.1 Tunics (coats) of eyeball. Abbreviations: Ant., anterior; Post., posterior.

Intermediate Vascular Coat (Uveal Tissue)

It consists of three parts:

1. Iris: It is the anterior most part of the uveal tissue.
2. Ciliary body: It extends from iris to ora serrata and is subdivided into two parts: anterior (pars plicata, 2 mm) and posterior (pars plana, 4 mm).
3. Choroid: It is the posterior most part of the uveal tissue. It lies in contact with sclera on its outer surface and with retina on its inner surface.

Innermost Nervous Layer (Retina)

It extends from optic disc to ora serrata. It ends abruptly just behind the ciliary body as a dentate border called ora serrata. It is concerned with visual functions.

Segments

The eyeball is divided into anterior and posterior segments (**Fig. 1.2**) by the lens, which is suspended from the ciliary body by fine delicate fibrils called zonules (suspensory ligaments of lens). Both anterior and posterior chambers communicate with each other through the pupil.

Anterior Segment

This includes structures anterior to the lens, that is, cornea, iris, lens, and part of ciliary body. The anterior segment is divided by the iris into an *anterior chamber* and a *posterior chamber*.

Anterior Chamber (OP6.3)

- **Boundaries:** The posterior surface of cornea *forms the* anterior boundary, while the iris, part of ciliary body, and surface of lens in the pupillary area *forms the* posterior boundary of the anterior chamber.
- **Depth:** It is 2.5 mm in center. It is shallower in hypermetropes and deeper in myopes.
- It *contains* a clear watery fluid called **aqueous humor** (0.25 mL).
- **Angle:** *Angle of anterior chamber* is a peripheral recess of the anterior chamber through which drainage of aqueous humor takes place.

Posterior Chamber

- It is a triangular space and *contains* aqueous humor.
- **Boundaries:** The posterior surface of iris and part of ciliary body forms the anterior boundary, while the lens, zonules, and ciliary body forms the posterior boundary.

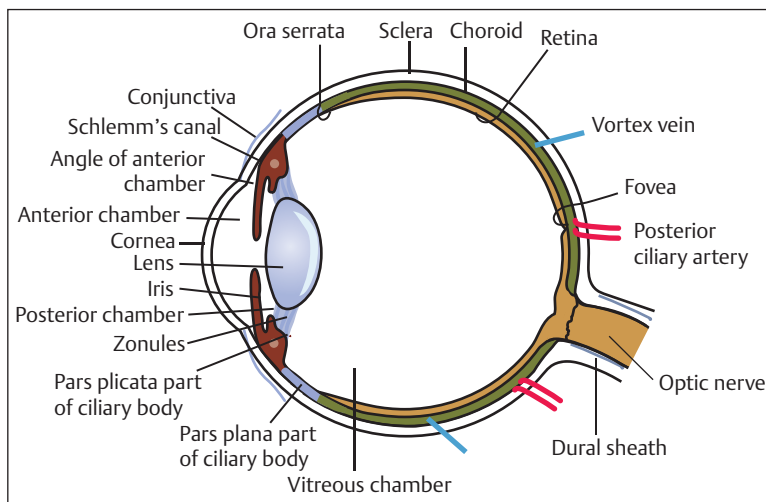


Fig. 1.2 Structure of eyeball.