Ophthalmology

Ophthalmology is the branch of medicine which deals with the anatomy, functions, and diseases of the eye. The term ophthalmologist refers to a specialist in medical and surgical eye problems. Since ophthalmologists perform operations on eyes, they are considered to be both a surgical and medical specialty.

The word ophthalmology comes from the Greek roots ophthalmos meaning eye and logos meaning word, thought or discourse; ophthalmology literally means "the science of eyes". "Ophthalmology" is a common mis-hearing or mis-remembering of the term. As a discipline, it applies to animal eyes also, since the differences from human practice are surprisingly minor and are related mainly to differences in anatomy or prevalence, not differences in disease processes. However, veterinary medicine is regulated separately in many countries and states/provinces resulting in few ophthalmologists treating both humans and animals.

History

The eye, including its structure and mechanism, has fascinated scientists and the public in general since ancient times. The majority of all input to the brain comes from vision. Many of the expressions in the English language that mean to understand are equivalent vision terms. "I see", to mean I understand.[1]

Many people when told that they may have an eye problem will be more concerned about diseases that affect vision than other, more lethal diseases. Being deprived of sight can have a devastating effect on the psyche, as well as economic and social effects, as many blind individuals require significant assistance with activities of daily living and are often unable to continue gainful employment previously held while seeing.

The maintenance of ocular health and correction of eye problems that decrease vision contribute greatly to the ability to appreciate the longer lifespan that all of medicine continues to allow. Given the importance of vision to quality of life, many ophthalmologists consider their job to be rewarding, as they are often able to restore or improve a patient's sight. As detailed below, advances in diagnosis and treatment of disease, and improved surgical techniques have extended our abilities to restore vision like never before.
Sushruta

Sushruta wrote *Sushruta Samhita* in about fifth Century BC. He described about 76 ocular diseases as well as several ophthalmological surgical instruments and techniques. Sushruta has been described as the first Indian cataract surgeon.[2] [3]

Pre-Hippocrates

The pre-Hippocrates largely based their anatomical conceptions of the eye on speculation, rather than empiricism. They recognized the sclera and transparent cornea running flushly as the outer coating of the eye, with an inner layer with pupil, and a fluid at the centre. It was believed, by Alcamaeon and others, that this fluid was the medium of vision and flowed from the eye to the brain via a tube. Aristotle advanced such ideas with empiricism. He dissected the eyes of animals, and discovering three layers (not two), found that the fluid was of a constant consistency with the lens forming (or congealing) after death, and the surrounding layers were seen to be juxta posed. He, and his contemporaries, further put forth the existence of three tubes leading from the eye, not one. One tube from each eye met within the skull.

Rufus

Rufus recognised a more modern eye, with conjunctiva, extending as a fourth epithelial layer over the eye. Rufus was the first to recognise a two chambered eye; with one chamber from cornea to lens (filled with water), the other from lens to retina (filled with an egg-white-like substance). Galen remedied some mistakes including the curvature of the cornea and lens, the nature of the optic nerve, and the existence of a posterior chamber. Though this model was roughly a correct but simplistic modern model of the eye, it contained errors. Yet it was not advanced upon again until after Vesalius. A ciliary body was then discovered and the sclera, retina, choroid and cornea were seen to meet at the same point. The two chambers were seen to hold the same fluid as well as the lens being attached to the choroid. Galen continued the notion of a central canal, though he dissected the optic nerve, and saw it was solid, He mistakenly counted seven optical muscles, one too many. He also knew of the tear ducts.

Middle Eastern ophthalmology

Of all the branches of Islamic medicine, ophthalmology was considered one of the foremost. It was during this period that ophthalmology began being treated as an independent medical discipline in its own right. As such, medieval islamic physicians are considered founders of ophthalmology as an independent discipline.[4] One of the pioneers of ophthalmology was the great Persian physician Rhazes. Scores of specialized instruments were developed. Innovations such as the "injection syringe", invented by the Iraqi physician Ammar ibn Ali of Mosul, which was used for the extraction by suction of soft cataracts, were quite common. In cataract surgery, Ammar ibn Ali attempted the earliest extraction of cataracts using suction. He introduced a hollow metallic syringe hypodermic needle through the sclera and successfully extracted the cataracts through suction.[5] Ali ibn Isa was born in Baghdad. His work, *Tashkirital-Kahhalin* (Notebook of the Eye Physician), the best and most complete text book on diseases of the eye. Ibn Isa’s book was the most widely referred to textbook by later ophthalmologists. It was first translated into Persian and then into Latin and printed in Venice in 1497 CE. Famous contemporaries of Isa Ibn Ali were Ammar Ibn Ali Al-Mosuli and Abul Hasan Ahmed Ibn Muhammad Al-Tabari who, in his work *Kitâb-ul Mu’âlaja ‘l-Bugratiyya* (Book of Treatment), says that he wrote a long treatise on diseases of the eye. Ammar Ibn Ali Al-Mosuli, from Mosul in Iraq, flourished around 1010 CE. He wrote a book entitled *Kitâb al-Muntakhab fi ilâj al-‘ayn* (Book of Choices in the Treatment of Eye Diseases) and practiced mainly in Egypt. His book deals with anatomy, pathology and describes six case histories for cataract operation and a case of optic neuritis. Ammar discussed some 48-eye diseases. Ammar was the inventor of the cataract operation by suction, using a fine hollow needle inserted through the limbus (where the cornea joins the conjunctiva). This was the
best-performed operation of its time. This type of cataract operation among others is still carried out today. Ammar throughout his work, as a surgeon and researcher, never forgot his compassionate attitude towards his patients. On his travels he fulfilled his religious duties, visiting Medina and performing Hajj at Mecca.

Ibn al-Haytham (Alhazen), the “father of optics”, studied the anatomy of the eye extensively. He made important contributions to ophthalmology and eye surgery and posited the first correct explanations of the process of sight and visual perception in his *Book of Optics* (1021).[^6] He was also the first to hint at the retina being involved in the process of image formation.[^7]

Ibn al-Nafis, in *The Polished Book on Experimental Ophthalmology*, discovered that the muscle behind the eyeball does not support the ophthalmic nerve, that they do not get in contact with it, and that the optic nerves transect but do not get in touch with each other. He also discovered many new treatments for glaucoma and the weakness of vision in one eye when the other eye is affected by disease.[^8] Salah–ud-din bin Youssef al-Kalal bi Hama (i.e. the eye doctor of Hama) was a Syrian oculist who flourished in Hama in 1296. He wrote for his son a very elaborate treatise of ophthalmology entitled Nur al-Uyun wa Jami al-Funun (light of the eyes and collection of rules).

### Seventeenth and eighteenth century

The seventeenth and eighteenth century saw the use of hand lenses (by Malpighi), microscopes (van Leeuwenhoek), preparations for fixing the eye for study (Ruysch) and later the freezing of the eye (Petit). This allowed for detailed study of the eye and an advanced model. Some mistakes persisted such as: why the pupil changed size (seen to be vessels of the iris filling with blood), the existence of the posterior chamber, and of course the nature of the retina. In 1722 Leeuwenhoek noted the existence of rods and cones though they were not properly discovered until Gottfried Reinhold Treviranus in 1834 by use of a microscope.

### Ophthalmic surgery in Great Britain

The first ophthalmic surgeon in Great Britain was John Freke, appointed to the position by the Governors of St Bartholomew’s Hospital in 1727, but the establishment of the first dedicated ophthalmic hospital in 1805; now called Moorfields Eye Hospital in London, England was a transforming event in modern ophthalmology. Clinical developments at Moorfields and the founding of the Institute of Ophthalmology by Sir Stewart Duke Elder established the site as the largest eye hospital in the world and a nexus for ophthalmic research.

### Professional requirements

Ophthalmologists are medical doctors (M.D.) who have completed a college degree, medical school, additional residency and internship training and further additional four to five years of postgraduate training in ophthalmology. In many countries, ophthalmologists also undergo additional specialized training in one of the many subspecialties. Ophthalmology was the first branch of medicine to offer board certification, now a standard practice among all specialties.

### Australia and New Zealand

In Australia and New Zealand, the FRACO/FRANZCO is the equivalent postgraduate specialist qualification. It is a very competitive speciality to enter training and has a closely monitored and structured training system in place over the five years of postgraduate training. Overseas-trained Ophthalmologists are assessed using the pathway published on the RANZCO website. Those who have completed their formal training in the UK and have the CCST/CCT are usually deemed to be comparable.
Canada

In Canada, an Ophthalmology residency after medical school is undertaken. The residency lasts a minimum of five years after the MD degree although subspecialty training is undertaken by about 30% of fellows (FRCSC). There are about 30 vacancies per year for ophthalmology training in all of Canada.

Finland

In Finland, physicians willing to become Ophthalmologists must undergo a five year specialization which includes practical training and theoretical studies.

Germany

In Germany, physicians willing to become Ophthalmologists must undergo a five year specialization of practical training.

India

In India, after completing MBBS degree, post-graduation in Ophthalmology is required. The degrees are Doctor of Medicine (MD) [9], Master of Surgery (MS), Diploma in Ophthalmic Medicine and Surgery (DOMS) or Diplomate of National Board (DNB) [10]. The concurrent training and work experience is in the form of a Junior Residency at a Medical College, Eye Hospital or Institution under the supervision of experienced faculty. Further work experience in form of fellowship, registrar or senior resident refines the skills of these eye surgeons. All India Ophthalmological Society (AIOS) [11] and various state level Ophthalmological Societies (like DOS [12]) hold regular conferences and actively promote continuing medical education. Royal colleges of the united kingdom, mainly Royal college of surgeons of Edinburgh (RCSEd) [13], Royal College of ophthalmologists (RCPht) [14] and Royal college of physicians and Surgeons of Glasgow (RCPSG) [15] are conducting their fellowship and membership examinations since mid 1990s and awarding fellowships and memberships to the successful candidates.

Pakistan

In Pakistan, after MBBS, a 2 year residency programme leads to FCPS in Ophthalmology. Moreover, MCPS and DOMS are also being offered.[16] M.S.(Ophthalmology) is also one of the specialty programmes. In addition to programmes for Doctors, various diplomas and degrees for Opticians are also being offered to produce competent Optic technicians in this field. These programmes are being offered notably by Punjab Institute of Preventive Ophthalmology (PIPO) Lahore, Pakistan.[17] Sub-specialty Fellowships are also being offered in the field of Pediatric Ophthalmology and Vitreo-Retinal Ophthalmology.

Philippines

Ophthalmology is a considered a medical specialty that uses medicine and surgery to treat diseases of the eye. To become a general ophthalmologist, a candidate must have completed a Doctor of Medicine degree or its equivalent (e.g. MBBS...), have passed the physician licensure exam, completed an internship in medicine, and completed residency at any Philippine Academy of Ophthalmology (PAO) [18][19] accredited program. Attainment of board certification in ophthalmology from PBO is optional, but is preferred and required to gain privileges in most major health institutions. Graduates of residency programs can receive further training in subspecialties of ophthalmology such as neuro-ophthalmology, etc. by completing a fellowship program which varies in length depending on each program's requirements. The leading professional organization in the country is the Philippine Academy of Ophthalmology [20][21] which also regulates ophthalmology residency programs and board certification through its accrediting agency, the Philippine Board of Ophthalmology.
**United Kingdom and Republic of Ireland**

In the United Kingdom, there are three colleges that grant postgraduate degrees in ophthalmology. The Royal College of Ophthalmologists grants MRCOphth and FRCOphth (postgraduate exams), the Royal College of Edinburgh grants MRCSEd, the Royal College of Glasgow grants FRCS. In Ireland the Royal College of Ireland grants FRCSI. Work experience as a specialist registrar and one of these degrees is required for specialisation in eye diseases.

**United States**

In the United States, four years of residency training after medical school are required, with the first year being an internship in surgery, internal medicine, pediatrics, or a general transition year. Optional fellowships in advanced topics may be pursued for several years after residency. Most currently practicing ophthalmologists train in medical residency programs accredited by the Accreditation Council for Graduate Medical Education (ACGME) and are board certified by the American Board of Ophthalmology. Some physicians train in osteopathic medical schools may hold a Doctor of Osteopathy ("DO") degree rather than an MD. The same residency and certification requirements for ophthalmology training must be fulfilled by osteopathic physicians. Completing the requirements of continuing medical education is mandatory for continuing licensure and re-certification. Professional bodies like the AAO and ASCRS organize conferences and help members through continuing medical education programs to maintain certification, in addition to political advocacy and peer support.

**Sub-specialities**

Ophthalmology includes sub-specialities which deal either with certain diseases or diseases of certain parts of the eye. Some of them are:

- Anterior segment surgery
- Cataract — not usually considered a subspecialty *per se*, since most general ophthalmologists perform cataract surgery
- Cornea, ocular surface, and external disease
- Glaucoma
- Medical retina, deals with treatment of retinal problems through non-surgical means.
- Neuro-ophthalmology
- Ocular oncology
- Oculoplastics & Orbit surgery
- Ophthalmic pathology
- Pediatric ophthalmology/Strabismus (mis-alignment of the eyes)
- Refractive surgery
- Uveitis/Immunology
- Veterinary Formal specialty training programs in veterinary ophthalmology now exist in some countries.[22][23][24]
- Vitreo-retinal surgery, deals with surgical management of retinal and posterior segment diseases and disorders. Medical retina and vitreo-retinal surgery sometimes together called posterior segment subspecialisation.
Notable ophthalmologists

Pre-18th century

• Detailed descriptions of delicate cataract surgery with sophisticated needle syringes is contained in the medical writings of Celsus (A.D. 14-37)
• Marie Colinet, wife of Wilhelm Fabry, employs a magnet for removing a foreign body from the eye, 1627.

18th-19th century

• Sir William Adams (UK) Founder of Exeter's West of England Eye Infirmary.
• Carl Ferdinand von Arlt (1812–1887), the elder (Austrian) proved that myopia is largely due to an excessive axial length, published influential textbooks on eye disease, and ran annual eye clinics in needy areas long before the concept of volunteer eye camps became popular. His name is still attached to some disease signs, e.g., von Arlt's line in trachoma. His son Ferdinand Ritter von Arlt, the younger, was also an ophthalmologist.
• Jacques Daviel (France) claimed to be the 'father' of modern cataract surgery in that he performed extracapsular extraction instead of needling the cataract or pushing it back into the vitreous. It is said that he carried out the technique on 206 patients in 1752-3, out of which 182 were reported to be successful. These figures are not very credible, given the total lack of both anaesthesia and aseptic technique at that time.
• Frans Cornelis Donders (1818–1889) (Dutch) published pioneering analyses of ocular biomechanics, intraocular pressure, glaucoma, and physiological optics. Made possible the prescribing of combinations of spherical and cylindrical lenses to treat astigmatism.
• Albrecht von Graefe (1828–1870) (Germany) Along with Helmholtz and Donders, one of the 'founding fathers' of ophthalmology as a specialty. A brilliant clinician and charismatic teacher who had an international influence on the development of ophthalmology. A pioneer in mapping visual field defects and diagnosis and treatment of glaucoma. Introduced a cataract extraction technique that remained the standard for over 100 years, and many other important surgical techniques such as iridectomy. Rationalised the use of many ophthalmically important drugs, including mydriatics & miotics. The founder of the one of the earliest ophthalmic societies (German Ophthalmological Society, 1857) and one of the earliest ophthalmic journals (Graefe's Archives of Ophthalmology). The most important ophthalmologist of the nineteenth century.
• Allvar Gullstrand (Sweden), Nobel Prize winner in 1911 for his research on the eye as a light-refracting apparatus. Described the schematic eye a mathematical model of the human eye based on his measurements known as the optical constants of the eye. His measurements are still used today.
• Hermann von Helmholtz, great German polymath, invented the ophthalmoscope (1851) and published important work on physiological optics, including colour vision (1850s).
• Hermann Snellen (Netherlands) introduced the Snellen chart to study visual acuity.
• Sir Arthur Conan Doyle (United Kingdom). English writer, primarily of the Sherlock Holmes stories. Trained in but apparently never practiced Ophthalmology.
• Jose Rizal (Philippines). The Philippines National Hero is a Ophthalmologist, One of his works was operation of his mother's eye for twice from cataract.
20th-21st century

- Connie McCaa (United States) Connie S. McCaa, MD, PhD), is a renowned cornea and refractive surgeon (ophthalmology); was one of the first in the country to perform LASIK; for 12 consecutive years is ranked among the Best Doctors in America; noted consultant surgeon to correct other physicians' patients' LASIK complications.[25]
- Vladimir Petrovich Filatov (1875–1956) (Ukraine) His contributions to the medical world include the tube flap grafting method, corneal transplantation and preservation of grafts from cadaver eyes and tissue therapy. He founded The Filatov Institute of Eye Diseases & Tissue Therapy, Odessa, one of the leading eye care institutes in the world.
- Ignacio Barraquer (1884–1965) (Spain) In 1917, invented the first motorized vacuum instrument (erisophake) for intracapsular cataract extraction. Founded of the Barraquer Clinic in 1941 and the Barraquer Institute in 1947 in Barcelona, Spain.
- Tsutomu Sato (Japan) Pioneer in incisional refractive surgery, including techniques for astigmatism and the invention of radial keratotomy for myopia.
- Jules Gonin (1870–1935) (Switzerland) "Father of retinal detachment surgery".
- Sir Harold Ridley (United Kingdom) In 1949, may have been the first to successfully implant an artificial intraocular lens after observing that plastic fragments in the eyes of wartime pilots were well tolerated. He fought for decades against strong reactionary opinions to have the concept accepted as feasible and useful.
- Charles Schepens (Belgium) "Father of modern retinal surgery". Developer of the Schepens indirect binocular ophthalmoscope whilst at Moorfields Eye Hospital. Founder of the Schepens Eye Research Institute in Boston, Massachusetts. This premier research institute is associated with Harvard Medical School and Massachusetts Eye & Ear Infirmary.
- Marshall M. Parks "Father of pediatric ophthalmology".
- José Ignacio Barraquer (1916–1998) (Spain) "Father of modern refractive surgery". In the 1960s, developed lamellar techniques including keratomileusis and keratophakia, as well as the first microkeratome and corneal microlathe.
- Tadeusz Krwawicz (Poland) In 1961, developed the first cryoprobe for intracapsular cataract extraction.
- Svyatoslav Fyodorov (Russia) Popularizer of radial keratotomy.
- Charles Kelman (United States) Developed the ultrasound and mechanized irrigation and aspiration system for phacoemulsification, first allowing cataract extraction through a small incision.
- Ioannis Pallikaris (Greece) Performed the first laser-assisted intrastromal keratomileusis or LASIK surgery.
- Fred Hollows (New Zealand/Australia) Pioneered programs in Nepal, Eritrea, and Vietnam, and among Australian aborigines, including the establishment of cheap laboratory production of intraocular lenses in Nepal and Eritrea.
- Ian Constable (Australia) Founded the Lions Eye Institute in Perth, Western Australia, the largest eye research institute in the southern hemisphere and home to ten ophthalmologists.
- L. L. Zamenhof (Poland) Creator of the Esperanto language.
- Bashar al-Assad (Syria) The President of Syria. He did his ophthalmology residency in a hospital in London.
- Syed Modasser Ali (Bangladesh) An ophthalmic surgeon who used to be the Director-General of Health Services for the government of Bangladesh. He wrote the first book on community ophthalmology (public eye health).
- Rand Paul (United States) libertarian politician
- David Taylor Pediatric ophthalmologist and author.
See also

- Eye care professional
- Eye examination
- History of eye colors
- Ophthalmology in medieval Islam
- Optics
- Optometry
- Orthoptics
- Pediatric ophthalmology
- Prentice position

External links

- American Academy of Ophthalmology [26]
- Jharkhand Ophthalmological Society [27]
- Philippine Academy of Ophthalmology [20]
- Ophthalmological Society of Pakistan [28]
- Association for Research in Vision and Ophthalmology [29]
- American Society of Cataract & Refractive Surgery [30]
- European Society of Cataract & Refractive Surgery [31]
- European Vitreo-Retinal Society [32]
- Royal College of Ophthalmologists [33]
- American Board of Eye Surgeons [34]
- American Board of Ophthalmology [35]
- International Council of Ophthalmology [36]
- Indian Journal of Ophthalmology [37]
- All India Ophthalmological Society [11]
- Delhi Ophthalmological Society [12]
- Ophthalmological Society of Bangladesh [38]
- The David G. Cogan Ophthalmic Pathology Collection [39]
- Royal College of Surgeons in Edinburgh [40]
- Canadian Ophthalmological Society [41]
- Daily Ophthalmology News [42]
- Difference Between an Optometrist and Ophthalmologist [43]

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