

The oldest written record of eye diseases dates back to the year 1500 B.C.: numerous diseases of the eye are referred to in the *Ebers Papyrus* discovered between the legs of a mummy in the Theban Necropolis in Egypt by the German professor *Georg Ebers* in 1872. And does the description "rising water in the eye" – as *Albertus Magnus* says – refer to cataracts? *Julius Hirschberg* sees it as likely that the description "darkening of the pupil and whitening disease of the eye" also includes cataracts; even *Martin Luther*, in his Bible translation of the Book of *Tobias* into German, translated *leucoma*, i. e. white coloring, as "Star" (the word used for 'cataract' in modern German).



The First Eye Operation - Cataract Surgery

What are cataracts?

Medicine began in Ancient Greece with *Hippocrates*. Yet the Hippocratics – *Hippocrates* and his pupils – could know nothing of a disease that matched the modern concept of cataracts as they had insufficient knowledge of the anatomical existence of the lens. None of the ideas of *Democritus*, *Hippocrates* or *Aristotle* features the lens in the anatomy of the eye. The writings of the Hippocratics contain only a few references that would seem to allude to cataracts. The most important of these comes from *Hippocrates* himself, a single word. The list of illnesses and diseases relating to old people in the *Aphorisms* include the following: dimness of sight, bluish opacity of the pupil, and dullness of hearing. The "bluish opacity" is a reference to cataracts.

The ancient study of cataracts has its roots in the Alexandrine era. Prior to this, different types of opacity seen in the pupil, which presumably included cataracts, were still grouped together. The Medical Schools of Alexandria knew of the existence of the lens. The usual name given to it for a long time was the "crystalline body".

From this point onwards, medicine went off on the wrong track and did not leave it again around 2000 years later. At that time, the lens was regarded as the main organ of sight – as the *divinum oculi*: it may become opaque but, because of its importance, this problem was regarded as inoperable. However, one particular problem that was operated on by means of a process known as cataract couching was seen to be something quite different. According to the theory on fluids that had

prevailed in ancient medicine since *Hippocrates*, the operable cataract was a liquid that had congealed in the pupil. This development and the importance of the ideas concerning the study of cataracts are made particularly clear by *Rufus of Ephesus* (1st/2nd century): "Glaucoma and hypochyma were regarded by the ancients as one and the same thing. Later generations, however, declared that glaucoma was a complaint affecting the crystalline fluid, which changes from its normal coloring into a watery blue color, and that hypochyma was an effusion of fluid, which (later) coagulates, between the iris and the crystalline body. All glaucomas are incurable; hypochymas are usually curable, though not always".

Hypochysis or hypochyma was a collective term for the great variety of different pathological changes in the region between the cornea, iris and



“The lens is just an optical medium”



lens. *Rufus* described the eye and was the first person to put the lens in its correct position. *Galen's* anatomy of the eye in the 2nd century comes even closer to the reality, although he still believed that the lens was the main organ of sight. His system, which is based on Hippocrates and the theory on fluids, remained uncontested for more than ten centuries. In the 7th century, *Paul of Aegina* in particular followed in the footsteps of *Hippocrates*, his ideas based on the writings of *Galen*. The Arabs translated his writings about cataracts and cataract couching. When the Roman Empire collapsed, the Arabs became the custodians of the Greek heritage and protected the Hippocratic-Galenic medicine from the West.

It was not until centuries later, in 1363, that the personal physician to the popes at Avignon, *Guy de Chauliac*, wrote his *Chirurgia Magna*,

a work that draws heavily on *Ali Ibn Isar* and *Galen*, in which he says: “The condition is a membrane – like spot in front of the pupil, which impairs sight due to extensive moisture that gradually penetrates the eye and coagulates because of the cold”.

The term “cataract” first appeared as a new term in the Middle Ages. In their translation of the Greek word “hypochysis”, the Arabs referred to the condition as “Nuzulelma”, “downflow of water”. To this very day, the Arabs call cataracts “the blue water”. It is generally accepted that the Catharginian monk *Constantine the African* (1015-1087), one of the most famous pupils of the School of Salerno, who in Monte Cassino also translated the “Ten treatises on the eye” of *Abu Zaid Hunain* (808-873) into medieval Latin, rendered the Arabic expression as “cataracta” (waterfall) in his work “*Liber de oculis*”.

Strictly speaking, the word cataract as a term for the opacity of the lens is just as inaccurate as the word glaucoma that has been used since the 19th century.

In 1543, in his extensive work “*humani corporis fabrica*”, the physician and anatomist *Andreas Vesalius* continued with the notion that the lens was located in the middle of the eyeball. In 1583, *Felix Platter*, official doctor to the city of Basel, wrote in his book “*de corporis humani structura*” one crucially significant sentence: “The lens is just an optical medium”. Yet, despite this, clinicians continued for the time being to keep faith with the old ideas.

The second half of the 17th century finally brought the required change in thinking. In 1656, the German anatomist *Werner Rolfinck* revealed that cataracts were the consequence of lens opacity. In 1682, the renowned

Left: Eye with cataract.

Middle: Cataract couching in the salon. Copper engraving from *Lorenz Heister*, Altdorf, 1713, Erlangen-Nuremberg University library, Germany.

Right: Modern surgical microscope – OPMI® pico i. Basic microscope for ophthalmologic examinations and operations.

**“I understand real cataracts
to be opacified humorem crystallinum
and not a layer of skin”**



Left: Modern intraocular lens (IOL).

Middle: Medieval depiction of cataract couching by Georg Bartisch from the 16th century.

Right: Eye with artificial lens implant.



French ophthalmologist *Antoine Maitre-Jan* observed, when couching the cataract, that it was not a thickened membrane that appeared in the anterior chamber but a thick round body, the lens. On April 6, 1705 the French doctor *Pierre Brisseau* made the same observation. Despite the misgivings of his teacher *Duverney*, he presented his findings to the Royal Academy of Sciences in Paris on November 12, 1705, after which he lost his position at the academy.

However, it was now no longer possible to restrain this new thinking. Too great was the authority enjoyed by the surgeon *Maitre-Jan*, who in 1707 published his “Tracté des maladies des yeux” and declared that in actual fact cataracts were an opacity and hardening of the crystal. *Charles de Saint-Yves* also writes in his treatise on the diseases of the eye, pub-

lished in 1722, that “I understand real cataracts to be opacified humorem crystallinum and not a layer of skin”. Any final traces of doubt were eliminated by *Jacques Daviel* in 1753 with his work on operating on cataracts.

The cataract operation

The main operating method for a very long time – from the 5th century B.C. until the 19th century A.D. – involved a technique known as cataract couching. This was joined from around 1750 until into the 20th century by extracapsular cataract extraction. The arrival of the 20th century saw more and more surgeons switching to the technique of intracapsular cataract extraction, which involves the full removal of the lens, i.e. including the lens capsule. Artificial lenses have been implanted in cata-

ract operations since the middle of the last century.

Cataract couching is apparently first described in Ancient Hindustan in the period around 500 years before Christ by the legendary Indian doctor *Susruta*. The first documented evidence of cataract couching can be found in the writings of *Chrysippos*, the Stoic philosopher from Soli, in the 3rd century before the birth of Christ. Cataract couching was unheard-of in Ancient Egypt and Classical Greece. The first, more or less accurate description is attributed to *Aulus Cornelius Celsus* from the 1st century and can be found in the chapter “De oculorum vitiis quae scalpello et manu curantur”.

Cataract couching involved pricking the sclera temporal with a needle (scleronyxis) and pushing the cataract into the vitreous body (depres-

sio lentis). Interestingly, the Indians practiced a somewhat safer method: they opened up the sclera with a sharp lancet and then introduced a blunt instrument to push it down, which meant that the risk of injury was smaller than with the use of just a sharp needle. Arab physicians even seem to have performed suction on soft forms of cataract.

Particularly impressive are the accounts of cataracts by *Georg Bartisch* in his eye manual "Augendienst", published in Dresden in 1583 [account from the surgeon, patient and assistant], and by the surgeon *Lorenz Heister* from Frankfurt in 1713.

The extracapsular cataract operation, in which the lens of the capsule is opened, was born in 1745: for the first time ever, *Jacques Daviel* removed a cataract through an incision in the cornea because blood and lens residue had entered the anterior chamber as a result of an unsuccessful couching operation.

The 18th century was also known as the age of the oculists, because cataracts were treated not just by hospital surgeons but itinerant oculists as well. One such cataract couching oculist of the 18th century was *Joseph Hillmer* from Vienna. He traveled across Europe, from Portugal to Russia. *Frederick the Great* appointed him a Professor of Ophthalmology at the Berlin Collegium Medico-Chirurgicum in 1748. Three years later, *Hillmer* was exposed as a charlatan. Even more well-known, but likewise of dubious character, was the itinerant "chevalier" *John Taylor*: on his carriage stood in bold letters "Qui dat videre dat vivere". In Leipzig, in 1750, he performed a cataract operation on both of *Johann Sebastian Bach's* eyes, but without success. *Bach* went completely blind and died four months later.

The same fate befell *Georg Friedrich Handel* in London in 1758. He too completely lost his sight following an operation carried out by *Taylor*. The itinerant cataract couchers

were followed in the 2nd half of the 18th century by the itinerant cataract cutters, who applied *Daviel's* method.

In Halle in 1806, *Wilhelm Heinrich Buchhorn* described cataract couching through the cornea, calling it keratonyxis. In the second half of the 19th century, extracapsular cataract extraction finally won the day once *Friedrich Jaeger* had introduced the cataract operation technique of an upper incision in the cornea. This triumph was also aided by improvements in the instruments that were used and the local anesthetic that was administered.

In 1922, Professor *Anton Elschnig* from Prague declared that in special cases the lens could be removed in its entirety, i.e. intracapsular extraction. Within a matter of decades, the intracapsular cataract operation had become an accepted practice. To avoid a prolapse of the vitreous humor, glycerin was given before the operation and oculopression was later applied. The removal of the lens was performed using capsule forceps. To prevent any laceration of the capsule, a suction cup was later used. Finally, cryoextraction became the method of choice. The operation was further facilitated by means of the enzymatic zonulolysis introduced by *Barraquer*.

Artificial lenses

Harold Ridley is regarded as the pioneer of lens implantation: in 1949, he inserted the first artificial lens as a posterior chamber lens in the capsular bag. 1952 to 1962 is the era of early anterior chamber lenses. Then came the Dutchman *Cornelius Binkhorst* with his iris clip lens, which he first used in 1958, though it took around another 15 years for the iris-supported lens to gain wider appeal. A further development was the medallion lens. Parallel to the iris-supported lens, experiments were being conducted into further developing implantation in the anterior chamber. Between 1963 and 1978, this

method is particularly associated with the name *Choice*. At the end of the 1970s, the second era of posterior chamber lenses began. The so-called „J-loop lens“, first presented by *Shearing* in 1977, which was fixed in place in the ciliary sulcus following an extracapsular operation, soon found universal appeal. It became the prototype for all subsequent lenses. Of crucial importance to this development was the phacoemulsification process introduced by *Kelman* in 1970. In the last two decades of the 20th century, the main focus was on developing new types of lenses, improving the operating technique and, above all, making it safer. Implantation in the capsular sac replaced sulcus fixation. Of vital importance for ensuring a safe capsule implantation is the precise opening of the anterior lens capsule. This only became possible with the help of the circular capsulorhexis technique indicated by *Thomas Neuhann* in 1985.

The development of foldable lenses made of silicone and acrylic together with small incision surgery were the real advances made in the 1990s. The latest developments include multifocal lenses, toric intraocular lenses to correct astigmatism and the incorporation of tiny sensors in the intraocular lenses (IOL) to continuously measure intraocular pressure.

The story of cataracts will continue and maybe one day the ophthalmologist's dream of refilling a completely emptied capsular sac with a flexible material, thereby restoring not just sight but also accommodation, will become a reality.

Gerhard Holland, History of Medicine and Pharmacy Collection, Christian Albrechts University Kiel, Germany
Dieter Brocksch, Carl Zeiss AG
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