Cataract: A historical perspective

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The earliest extant description of a surgical operation for the cure of cataract is that of Celsus, who practiced medicine in Rome at the beginning of the Christian era. In his text De Medicina he described in detail his method of couching, by which he inserted a bronze needle into the eye at the equator on the lateral side of the globe and depressed the cataract downward into the lower part of the vitreous where the surgeon hoped it would remain out of the way of vision. The same method had been employed by the Greeks and Hindus for at least several hundred years earlier and was to continue as the only operation available until the middle of the eighteenth century when Daviel of Paris described extraction of the lens through the cornea. The early couchers worked on the premise that the crystallin humor we know as the lens was the receptor for vision, and that in certain conditions of disease a suffusion flowed down in front of the crystallin humor where it solidified and formed a dense curtain. The purpose of couching was to press the hardened corrupt humor out of the way of the lens. That cataract was opaque material within the lens itself was not recognized until after the middle of the seventeenth century. Until then the surgeons were not even aware that it was the lens they were dislocating.

The program arranged by Dr. John E. Harris, to which many of you will contribute during the next few days, is truly impressive. Those of us not engaged in investigative work on the lens can scarcely understand even the titles of the papers, and we envy you who can. My contribution to the program is to describe some of the earliest steps in the study of the lens, especially of cataract. This involves the surgical operation for cataract, undertaken long before the actual location of the opacity was known, the later discovery of the true position and function of the lens, and finally the real nature of cataract.

Early notions of cataract

A historical survey of cataract might begin with Celsus, who wrote the earliest extant description of a surgical operation for its cure. Aurelius Cornelius Celsus practiced medicine in Rome at the beginning of the Christian era; he was probably one of the best physicians of his day and his patients were of the upper classes. He wrote an encyclopedia in which he assembled a wide range of knowledge; none of this has survived except the portion entitled On Medicine. It is not an original work, but a compilation in Latin of earlier Greek texts, and was completed about A.D. 29.

According to Celsus the eye possesses two outer tunics, the horny ceratoides (the cornea and the sclera) and the vascular chorioides (uvea) which is pierced by a hole at the site of the pupil, and one inner tunic, the spider web–like arachnoides of unknown function (retina). The cup formed by the latter contains the gelatinous hyaloides (vitreous) (Fig. 1). Lying in front of the hyaloides is the crystalloides...
Fig. 1. The anatomy of the eye as depicted by contemporaries of Celsus. (From Magnus, H.: Die Augenheilkunde der Alten, Breslau, 1901, Kern.)

(lens); it consists of a drop of humor resembling the white of an egg, and is the seat of the faculty of seeing. In front of the crystalloides and behind the pupil he described an empty space, the locus vacuus. Under certain conditions of disease a thickened humor flows down into this space where it solidifies, forming a suffusion, or cataract.

The purpose of surgical treatment for this condition was the depression of the hardened humor out of the way of the crystalloides which was the receptor for vision. The common English word for the operation is "couching," that is, the laying of the opaque material on a couch or bed at the bottom of the eye. It has also been called "reclination" or "depression."

Celsus described the operation for the relief of cataract as follows (see Fig. 2):

The patient is to be seated opposite the surgeon in a light room, facing the light, while the surgeon sits on a slightly higher seat; the assistant from behind holds the head so that the patient does not move; for vision can be destroyed permanently by a slight movement. In order also that the eye to be treated may be held more still, wool is put over the opposite eye and bandaged on: further the left eye should be operated upon with the right hand, and the right eye with the left hand. Thereupon a needle is to be taken pointed enough to penetrate, yet not too fine; and this is to be inserted straight through the two outer tunics at a spot intermediate between the pupil of the eye and the angle adjacent to the temple, away from the middle of the cataract, in such a way that no vein is wounded. The needle should not be, however, entered timidly, for it passes into the empty space; and when this is reached even a man of moderate experience cannot be mistaken, for there is then no resistance to pressure. When the spot is reached, the needle is to be sloped against the suffusion itself and should gently rotate there and little by little guide it below the region of the pupil; when the cataract has passed below the pupil it is pressed upon more firmly in order that it may settle below. If it sticks there the cure is accomplished; if it returns to some extent, it is to be

Fig. 2. Couching cataract. As practiced in Renaissance Germany, the method differed little from that of Celsus. (From Bartisch, George: Augendienst, Dresden, 1583, Matthes Stockel.)
cut up with the same needle and separated into several pieces, which can be the more easily stowed away singly, and form smaller obstacles to vision. After this the needle is drawn straight out; and soft wool soaked in white of egg is to be put on, and above this something to check inflammation; and then bandages.*

This method, of course, was not original with Celsus. It was probably employed several hundred years earlier in India and Greece and by Greek physicians at Alexandria. Its origin is not known.

Discovery of position and function of lens

The concept of the location and the function of the lens and the nature of cataract remained unchanged throughout the Dark Ages and well into the Renaissance. For example, Leonardo da Vinci, in a sketch of a sagittal section of the head in 1490 (Fig. 3), still shows the crystalline humor, or lens, in the center of the eye. A canal leads to it from the pupil. The membranes of the brain extend forward to form the sheath of the optic nerve and the coats of the eyeball. Vesalius in his great work on anatomy, De humani corporis fabrica of 1543, illustrated the eye (Fig. 4) with its lens in the center and a large, imaginary space between it and the pupil.

The true position of the lens within the eye finally was demonstrated by dissections by Hieronymous Fabricius ab Aquapendente, Professor of Anatomy at Padua, Italy, and illustrated in his De Visione, Voce et Auditu of 1600. His drawing (Fig. 5) shows for the first time the lens directly behind the iris and not separated by a "vacant space."

For the sake of complete accuracy it should be noted that several earlier writers, in describing the location of the lens, had moved it forward from the center of the globe toward its actual location. According to Duke-Elder and Wybar these include Rufus of Ephesus (beginning of the second century A.D.) and Galen (toward the end of the second century), and, according to Ford, of Celsus: De Medecina, translated by Spencer, W. G., Loeb Classical Library, Cambridge, 1953, Harvard University Press.


O'Malley and Saunders, Realdus Columbus (c. 1559) and Felix Platter (1583). The theory of vision of that day held that small particles shot out from the eyes and were reflected back to the crystallin humor (lens) which was the receptor for vision. Platter took away the function of photo-receptor from the lens and granted it to the retina. This new concept was used by Kepler in his Dioptrice of 1611, and by Scheiner in his Oculus hoc est: Fundamentum Opticus of 1619. In the latter text appears for the first time an accurate diagram of the eye (Fig. 5), with the lens in its position and the optic nerve, not directly behind the pupil as in all previous diagrams, but toward the nasal side.

During all this time confusion had persisted about the true nature of cataract. The notion was that under certain condi-
Fig. 4. Section of the eye from Vesalius' *De humani corporis fabrica* of 1543. The "vacant space" between the iris and lens is clearly evident.

Fig. 5. Section of eye by Fabricius (1600) and section of eye by Scheiner (1619). (Reprinted from *The Retina*, by S. L. Polyak, by permission of the University of Chicago Press. Copyright 1941 by The University of Chicago. All rights reserved.)

Real nature of cataract

The concept of cataract held by Celsus and his predecessors persisted until the latter half of the seventeenth century. The first to conceive the idea that cataract is an opaque lens is said to have been François Quaré, a physician and surgeon in Paris, about 1643. Eight years later, in 1651, Remy Lasnier, an oculist and lithotomist, proposed the same idea in a thesis before the College of Surgeons of Paris. Werner Rolfinck in 1656 was able to confirm the speculation that a cataract is an opaque lens.

Some anatomists and surgeons accepted this new notion, others denied it. Pierre Brisseau, physician-in-chief of the Royal Hospitals, performed dissections before the Royal Academy of Sciences in 1705, demonstrating that the lens is the site of cataract, and Antoine Maitre-Jan in 1707 showed that cataract is clouding of the lens. Actually, then, not until the 1700's was the true nature of cataract generally recognized.

Until the middle of the eighteenth century the accepted surgical approach to cataract was couching. The only exception had been removal by suction through...
glass or metal tubes, a method attempted by various surgeons over the centuries, apparently with negligible success.

In 1748 the French oculist, Jacques Daviel, published the first account of extraction of a cataractous lens through the pupil and out of the anterior chamber. Five years later, in 1753, he published his classic detailed account of the operation he had devised and the instruments he had designed for it. He reported that he had performed the operation 206 times and was successful 182 times. The instruments he used are shown in Fig. 6 and his method of using them in Fig. 7. His description of his technique, illustrated in the latter figure, follows (the translation of the original French is by Thomas Hall Shastid):

The patient is set on a rather low stool, or on a chair without any back. The operator sits upon a higher chair, in front of the patient and facing him, so that the former, while he operates, can support his elbows with his knees.

He covers the other eye with a bandage. Then an assistant, standing behind the patient, lays one hand upon his forehead, lifting the upper lid with two fingers, while the second hand is laid beneath the patient's chin.
Fig. 7. Daviel's illustration of technique of cataract extraction (1753).

The surgeon draws down the lower lid, A, see figures, seizes the first needle [now called a keratome], sinks it into the anterior chamber, close to the sclera, while he avoids all injury to the iris, and passes it higher than the pupil, then he draws the needle very gently out again, takes up the blunt-pointed needle, and enlarges therewith the incision already begun, drawing the instrument to right and left, in order to open the cornea in the form of a half-moon, corresponding to its curvature (CC).

But, as the cornea is then a little flaccid, the surgeon takes up the curved, convex scissors (D), brings its blunt arm between cornea and iris, and completes the incision first upon the one, then on the other, side (EE), in order to bring it on each side a little above the pupil.

One should, of course, observe that the convexity of the scissors must be directed toward the eye. With respect to the curvature-on-the-flat, therefore, two pairs of scissors are essential, which fit the curvature of the cornea as well on the nasal as on the temporal side.

The surgeon takes then the small spatula (F), raises with it gently the separated portion of the cornea (G), and incises with the little edged and pointed needle (H) the capsule of the lens. Sometimes one has to cut this membrane all around and remove it in its entirety, when it is thickened and folded; and then it can be drawn out; when well cut round, with the tiny forceps. When one has circumcised the membrane which enclosed the lens, then he must carefully introduce the small spatula between the body of the
lens and the iris, in order to make the cataract entirely free and to facilitate its exit. Now the surgeon needs all his foresight. He is about to remove the veil that covers the light. To this end he presses very gently on the ball, avoiding even the slightest pain. (Note the fingers so employed, II.) Thus the operator avoids rupturing the posterior capsule of the lens, which acts like a dam to prevent the exit of the vitreous humor. With delight is seen the gradual dilation of the pupil, and the soft gliding hither of the lens (which first allow its margin to appear) in the anterior chamber and from there upon the cheek. At once the pupil is clear; the cloud which covered the eye has been dissipated; the patient, who before was plunged in darkness, glimpses the day with astonishment and satisfaction.*

Surgical extraction of cataract today is surprisingly similar to that described by Daviel 200 years ago. Some of the innumerable modifications proposed since then have improved its safety and effectiveness. Daviel's results seem remarkably good when one realizes that he worked a hundred years before the causes of infection were discovered and before any effective general or local anesthesia was available.

**Conclusion**

You who are gathered here for the next few days to discuss the detailed structure of the lens and the chemical processes occurring within it are adding to knowledge established by a host of anatomists and physiologists. In a sense you are also successors to Celsius and to Daviel.

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**REFERENCES**
