Evolution of Cataract Surgery
The Dark Ages to New Age Micro Phaco

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Cataract surgery in its simplest form is at least 4000 years old. Couching for cataract was the earliest method at about 2000 BC, and even then was evidently practiced in the Tigris / Euphrates area, India and Japan. The earliest records are from the early Hindu records of Susruta’s time and from Bible and Red Sea Scrolls. Records exist from 400 BC (in Hippocrates time) and from 10 AD and 200 AD (from Roman records), as well as later Arabic references, but there is little evidence in Europe during the middle or dark ages.

The premodern era dates from Daviel’s original extra-capsular surgery in 1748 leading to the advances of the late nineteenth and twentieth centuries via intra-capsular surgery, implant lens prostheses, and the present small incision phacoemulsification surgery.

Several philosophers have reminded us that those who forget the mistakes of the past are destined to repeat them in the future. In this historical survey it is hoped that knowledge we inherited will be an incentive for us to continue to strive to improve the quality of life of our patients.

The history of intervention for cataract, though shrouded in the mists of time, is as ancient as any surgical discipline. Before 2000 BC, the code of Hamurabi is unspecific on surgery, but it is possible that the Babylonians used lens depression for cataract by forcing the lens from its zonular attachments by digital pressure on the globe. Japanese surgeons, about 2000 BC or before, had access to relatively advanced metallurgy and used sharp needle knives and fine gold canulae to suck out hypermature (liquefied) cataracts. There are from our own early Hindu references to Couching surgery for cataract by Susruta, using incision and instruments pressing on the lens itself in order to displace it from the pupil into the vitreous gel. If the lens capsule remained intact (intracapsular couching) this approach could be quite successful, giving brighter although unfocused vision. In cases where the capsule was ruptured (extra capsular couching), severe uveitis would later usually destroy the eye, and there would be the ever-present hazard of severe infection (endophthalmitis). It is uncertain whether Susruta lived before or after Alexander in India (339 BC), and whether he influenced (or was influenced by) the Aesculapian period of Greek medicine of which Hippocrates of Cos (460-377 BC) is best recognised. These Greek surgeons undoubtedly used couching and much of their knowledge was passed to Alexandria and later to Rome, but the written records of Alexandria were lost with the destruction of the great library. However, Roman records do exist, particularly the Greek ophthalmological terminology, which the Romans largely adopted and which persists to the present day.

The earliest written description of (self) couching is in The Apocrypha of the Bible, in the book of Tobbit, fragments of which persist in the Dead Sea Scrolls, and can be dated very close to 612 BC, the fall of Nineveh within Tobbit’s lifetime. Tobbit attributed his progressive blindness when he was 62 years old, to sleeping under the wall of his courtyard in Nineveh; “And mine eyes being open, the sparrows muted warm dung into them, and a whiteness came into mine eyes.” The ‘whiteness’ description is very reminiscent of ‘chitta motia’ or the white blindness = cataract in modern Urdu and Hindu. Tobbit’s blindness was not immediate. When he was about 70, his son Tobias returned from a long journey from Rhages in Media, to collect a debt. During this journey, a fish leaped from the river Tigris and almost swallowed his foot. Tobias and his friend ate the fish, but retained the heart, liver and the gall [bladder], being instructed “...to anoint a man that hath the whiteness of the eyes and he shall be healed.” At this point the story diverges to Sarah, a woman whose seven previous husbands had died on their wedding nights. Tobias survived his marriage to Sarah, and on reaching home ‘Anna the wife of Tobbit saw him from afar.’ Tobbit, who was by now blind, stumbled at the door, but his son Tobias took hold of his father and “...Strake of the gall on his fathers eyes, saying ‘Be of good hope my father.’ And when his eyes began to smart, he rubbed them; And the whiteness piled away from the corners of his eyes: and when he saw his son he fell upon his neck. This is an account of self couching by rubbing [hard] in response to severe irritation of the gall (Bile), producing an immediate return of vision. Bile is highly irritant but also contains detergents and enzymes (i.e. chymotrypsin) which would weaken the zonules.
In Rome, Celsus (25BC-50AD) practiced couching by slim flat needles. Pliny (23-79 AD) recorded that Hyoscyamus (Henbane, an atropine like herb) was used to dilate the pupil for couching. Galen (131-210AD) wrote that evacuation of the lens was attempted by suction. His description of preparing [the theatre] for surgery bears resemblance to current practice; clearly there was a good comprehension of ‘contagion’.

It is remarkable that these operations on the lens were done with highly inaccurate knowledge of the anatomical position and function of the lens, which was thought to be the seeing tissue of the eye, the lens being displaced by couching to allow ‘sufficio’ (or a humor) from the locus vacuus, (the combined anterior and posterior chambers) to perfuse back to the (supposedly) hollow optic nerve.

With the fall of Rome, much of this knowledge was lost in the Europe of the dark ages, but it was transported into the Arab world by the migrations of the origins of Islam, so that Ammar Ben Ali was able to describe lens aspirations by fine glass tubes. From this Arab route, later translations were made back into Latin, Provencal, Old French and English. Couching practice was taken to Africa, where quite recently it was still being done by a stick or thorn. In England, Chevalier Taylor, an itinerant practitioner, couched for cataract and moved on before the frequent uveitis destroyed the eye. George Frederick Handel was blinded in one eye in this way.

Fabricius located the true position of the lens and established the use of convex spectacles after couching for cataract. Jacques Daviel started a revolution in the ophthalmic surgery on April 8 1747. A couching procedure failed, so through an inferior corneal incision he inserted a needle behind the lens and delivered it with some vitreous. This was the first reported case of cataract extraction from behind the iris. In 1753, he presented one of the landmark articles in the ophthalmology history to the Royal Academy of surgery. He reported 115 cataract extraction with 100 successes. By 1756 he had performed 434 extractions with only 50 failures. He did his surgery using an inferior section incision by needle knife, or a keratome and curved scissors, extracapsular extraction. He reported case of cataract extraction from behind the iris. In 1753, he presented one of the landmark articles in the ophthalmology history to the Royal Academy of surgery. He reported 115 cataract extraction with 100 successes. By 1756 he had performed 434 extractions with only 50 failures. Without suturing was rare. (i.e. the first half of the 20th century).

It is remarkable that the intracapsular was born during this same period when it was introduced in 1880 by Smith. After section and iridectomy, and with the pupil dilated, the lower part of the anterior capsule was grasped by forceps (and by a variety of rocking manoeuvres the zonules were weakened and broken from the ciliary muscle (usually without rupture of the capsule). The lens was then delivered upside down by an action known as tumbling. Excess pulling could cause either capsule rupture or vacuum at the vitreous face, which might rupture and cause macular oedema and subsequent retinal detachment. In the Kirby technique, the capsule was grasped near its upper pole and the lens slid out after breaking the upper zonules. Samuel Sharp of London and George de la Faye are credited with the first such procedure. Sharp expelled the lens from the eye with the pressure of his thumb. Shortly thereafter a more direct method was adopted by Richter who pushed the lens out after impaling its posterior pole with a needle thrust through the sclera. Pagenstecher (1866-1871) introduced a spoon to remove the lens out of the globe. Then Col. Henry Smoith (1900-1926) popularized lens removal with the help of stabimus hook. Many distinguished surgeons of that time still practiced couching as the newer techniques were difficult to master and were also associated with higher incidence of infections.

Von Graefe (1860) designed narrow bladed knives that were exceptionally sharp and long thereby permitting superior incisions. He also introduced iridectomy, subsequently shown to avoid pupil block caused by synechiae (Occlusio pupillae).

Belladonna Atropa (Deadly nightshade) was used to dilate the pupil from 1796 giving better visualisation and post operative control of synechiae. Atropine was synthesised from this alkaloid in 1831 and cocaine anaesthesia (an improvement on laudanum) was used first in 1884, both topically and by injection.

These pharmacological advances were accompanied by improvements in illumination, first by spot projecting lamps often with blue or other filters to show up capsule & lens cortex. Magnifying near vision glasses and telescopic loupes gave support to older emetropic and hypermetropic surgeons, allowing a better microscopic view of the operative field. Improved manufacturing and metallurgy led to the development of better steel instruments during the 19th and 20th centuries. Von Graefe’s knife was widely used until the 1970’s, when it began to be displaced by scalpel and scissors, or razor blade fragments, and later by small micro blades of diamond or ruby. The Graefe knife required considerable dexterity and skill but could produce a near limbal section and conjunctival flap in one sweep. The conjunctival flap improved the stability of the upper limbal wound at a time when suturing was rare. (i.e. the first half of the 20th century). These weak wounds were aided by immobilising patients between sandbags or pillows, and restricting them to soft non constipating food for 10 days post op. Occasionally iris
phenomenon, i.e. objects crossing the field of view would.

Fortunately, the Cartella shield, a shelf of aluminium or card made to rest on the nose bridge, forehead and cheek (with a firm eye pad underneath) gave some protection to the fragile wounds from the patients’ curiosity and inopportune investigating finger.

The first attempt to introduce an intraocular lens was by Casaamata in 1795 when he tried a glass IOL which immediately slipped towards the retina. But despite this, it is still remarkable that this attempt preceded Ridley’s first case by more than 150 years.

Because of the relatively high incidence of post operative iris prolapse, silk and cotton sutures were used to close the corneal wound in 1890.

After a presentation by Smith on a visit to USA, Green and D Vail left for India. They worked with Smith and performed the Indian surgery under the tutelage of the master.

Up on there return, Greene published a paper in 1910 on Smith surgery. Vail at 1910 AAO meeting presented a paper and gave a detailed lantern demonstration of the unmodified smith surgery.

In 1911 GF Keiper presented a paper in AAO which said cataract surgery in elderly were risky due to prolonged forced bed rest leading to DVT and embolism, delirium, prostatic obstruction.

In 1940 ICCE was the procedure of choice and post placed corneoscleral suture was the suturing of choice. A milestone in cataract surgery occurred in 1957 when Joaquin Barraquer discovered that enzyme alpha chymotrypsin could cause zonulysis thereby facilitating the delivery of the lens.

Krawicz was the first to introduce cryoextraction of cataract. Kasner managed intraoperative vitreous loss by doing anterior vitrectomy initially with sponge and later with automated devices.

Post-operative refraction was usually carried out at 10-14 weeks allowing for healing / astigmatic changes to stabilise. The typical final refraction for previous emetropes was of the order of +10.00/+3.00 x 180. While in most cases patients had good acuity the lenses were heavy, had spherical aberration, and had a spectacle magnification of 25%. This magnification could cause diplopia, and was a problem when there was a long time gap between surgery on the two eyes. Contact lenses reduced this image disparity to 7%, but were not always satisfactory in the aged. The highly curved optics of aphaic glasses also gave rise to the ‘Jack in the box’ phenomenon, i.e. objects crossing the field of view would be unfocused outside the lens edge, would disappear in the refractive scotoma only to appear suddenly magnified in the central field. Attempts to reduce these optical defects included lenticular lenses with a small central optic with a plano outer zone. ‘High drop’ lenses, of aspheric design had moderate success in the late 1960’s.

In 1949 Sir Harold Ridley observed that plexiglass (methylmethacrylate) fragments from spitfire canopies were inert in the injured eyes of pilots. From that observation he designed the first ever perspex intra-ocular lens. One of the most important events in cataract surgery during the past century occurred in November 29, 1949 when Harold Ridley implanted his first intraocular lens. He tried to introduce this IOL which weighed 112 mg in the posterior capsule bag which was possible after an ECCE. His procedure was abandoned because of height incidence of postoperative complications.

A resurgence of enthusiasm for lens implantation occurred when lenses that depended on the iris for support was designed. The major credit for this goes to Binkhorst who developed his iris-clip lens in 1957 and used for the first time in August 11 1958. Binkhorst later realized that the ECCE technique was advantageous, so he removed the anterior loops from his four loop iris clip lens and used it as a capsule supported lens in 1963. He along with Kelman is most responsible for a return of ECCE after 30 years of preference for ICCE.

Charles Kelman in 1967 made one of the most important contributions to cataract surgery during the past century when he introduced the technique of phacoemulsification. Initially surgeons questioned the need for this procedure when there already exists a reliable successful procedure. The new method involved radical changes in technique and a painful learning curve. The other surgeons tried in many ways to thwart its progress.

At the 1974 AAO meeting the Academy Committee on Phacoemulsification reported the results of a survey of 400 ophthalmologists comparing ICCE, ECCE and Phaco. The conclusion was the phaco did not yield results inferior to ICCE.
Continuous cuvelinear capsulorexis was introduced by Gimbel and Neuhann. This ensured better placement of PCIOL.

Meanwhile in the 1970s John Pearce developed a new reduced incision microsurgery, with implantation of the IOL in the posterior chamber. Galand in Liege, refined this to 'endocapsular' implantation, i.e. into the natural place, the capsular bag. There was one disadvantage; capsular epithelial regeneration could cloud the pupil later, but physics came to the rescue with the development of the YAG laser capsulotomy (Fankhause 1983). At this time, surgical microscopes with foot pedal controls gave better visibility during surgery. A scan Ultrasonography, by measuring the axial length of the eye, increased the precision of implant calculations.

Over the next decades experience has proved that ECCE and phacoemulsification combined with PCIOL implantation achieved an unprecedented level of success.

Many a times it was thought that cataract surgery has reached its ultimate level of perfection. But then the time has proved them all wrong, yet in the era of MICS with multifocal and accommodating IOLs if anybody thinks, yes this is it then again time will prove them to be wrong. Cataract surgery has not reached its pinnacle and probably never will unless cataract becomes preventable. Hmm a new idea. Truly an idea can change our lives.