Abu Al-Qasim Zahrawi’s contribution in ophthalmology

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ABSTRACT:
Abu al-Qasim Zahrawi (A.D. 936-1013) was considered the greatest medieval surgeon. He has been described by many as the father of surgery. His greatest contribution to medicine is the Kitab al-Tasrif, a thirty-volume encyclopedia of medical & surgical practices. His pioneering contributions to the field of surgical procedures and instruments had an enormous impact in the East and West, as well into the modern period, where some of his discoveries are still applied in medicine & surgery. Al-Zahrawi had a special interest in eyelid surgery. He gave sensible suggestions on the use of fine instruments, of which he had a wide variety. The third volume described detailed procedures of performing ophthalmic operations including “cataract”. He described surgical management of different pathological conditions i.e. Entropion, Entropion, trichiasis, ptosis and symblepharon. Abu-al-Qasim was specialized in curing disease by cauterization. He describes about more than 20 cauterizes for specific indications, these include the punctuate cauter and the crescentic cauter for Posis of eyelids, lacrimal and perianal fistula are some examples of the beneficial and effective cauterization. He invented several devices used during surgery, for purposes such as inspection of the interior of the urethra, applying and removing foreign bodies from the throat, inspection of the ear, etc. The finely pointed scalpel to cut up a swollen foreign body in the ear, eye speculum, fine conjunctival hooks, ophthalmic scissors, fine couching needles, scrappers for teeth, forceps for the removal of broken roots of teeth and for the wiring of teeth, and the use of ox bone for artificial teeth. The operative removal of a ranula and the use of a tonsil guillotine and mouth gag in a tonsillectomy are among the original discoveries of Al-Zahrawi. The details of ophthalmic Surgerie among above will be presented in full length paper.

Key words: Father of Surgery, Kitab al-Tasrif, Instruments for cauterization, ophthalmic Surgeries.

INTRODUCTION
As a Hakim, the history of medicine has always fascinated me. We can learn a lot from where we came from, heading into the future knowing what has in our history. Many of the instruments pictured here maybe failed, but they were the backbone of what modern medicine has become and what its tools were modeled after.
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The earliest independent work in Arabic Spain to embrace the whole of medical knowledge of the time is the encyclopedic Al-Tasrif, written in the late 10th century by Abu al-Qasim al-Zahrawi, also known as Albucasis. It consists of 30 treatises which brought him high prestige in the western world. He is considered as father of surgery as he became famous throughout Europe for teaching new methods of surgery and inventing several instruments which were used in most of Europe until 17th - 18th century. In addition to his knowledge of medicine and surgery he was very skilled in the use of simple and compound remedies and thus he was also known as the “Pharmacist Surgeon”. He wrote extensively on cardiac drugs, emetics, laxatives and cosmetology. Translation of Al Zahrawi’s work “Liber Servitoris” provide readers an explanation of preparing simple and compound complex drugs that generally used in those days1.

In Al Tasrif, Zahrawi stated that learning the art of surgery is lengthy and a good practice in surgery required sound knowledge of anatomy. “He who devoted himself to surgery must be versed in the science of anatomy.”2

He was considered one of the early leading “plastic surgeon” as he performed many plastic surgery procedures. In the 11th chapter of volume 30 of his book he put many principles in that surgical field3.

Al Zahrawi’s writings were translated into Latin and were used as the standard book of medicine in Europe for several centuries. His writings on anatomy and surgery raised him to the level of Hippocrates and Galen. In fact his work represented the first step of surgery as an independent specialty away from medicine, grounded on the knowledge of anatomy. Al Tasrif became famous in the universities of Europe in the middle ages and was the chief reference work for surgery in the universities of Italy and France.4

His pioneering contributions to the field of surgical procedures and instruments had an enormous impact in the East and West, as well into the modern period, where some of his discoveries are still applied in medicine & surgery.

Abu-al-Qasim was specialized in curing disease by cautery. The cautery was employed to an almost incredible extent in ancient times, and surgeons expended much ingenuity in devising different forms of this instrument. The cautery was employed for almost every possible purpose: as a ‘counter-irritant’, as a homeostatic, as a bloodless knife, as a means of destroying tumors, etc. The cautery as a means of controlling hemorrhage is in principle being used today by every surgeon in the form of the electro-surgical unit. Various methods were described and devices were invented up to now in order to increase safety and decrease time consumption and complications. All new created devices

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Fig 3-Leaves 157 and 158 are part of a chapter on cauterizing: two illustrations of cauterizing instruments (metal rods with extremities).
promises lower intraoperative blood loss and time, postoperative pain and bleeding. Cauterization was widely employed to treat wounds of every type for they were convinced that it would speed healing, prevent infections and facilitate hyperemia.

Albucasis describes about 20 types of cauteries for specific indications. Various types of cauterizations, from head to the foot, are mentioned for every conceivable disease. These include the olivary cautery for a variety of indications including headache, the bolt and tube cautery for migraine, the punctuate and crescentic cautery for Ptosis, the probe cautery for lacrimal and perianal fistulae, the ring cautery for sciatica, and the quill cautery for corns, the pronged cautery for humeral dislocation. Three-pronged cautery irons used by Albucasis, which would have been thrust, white-hot, into the shoulder joint to scarify and tighten the tissues to prevent recurrent dislocation. Only a small percentage of these cauterizations are truly sharp cutting cautery as for hare-lip, the cauterization of hemorrhoids, the cautery for Ptosis of eyelids, the cauterization for Entropion. The invention of a large number of surgical instruments and their original operations are ascribed. These include the finely pointed scalpel to cut up a swollen foreign body in the ear, eye speculum, fine conjunctival hooks, ophthalmic scissors and fine couching needles. Al-Zahrawi generally preferred Cauterization done by heat (where the tissue trauma is localized). Depending on the nature of the disease, the patient's temperament and the weather condition, different kinds of metals such as bronze, iron and gold could be used.

The important considerations in the procedure include the shape of the cautery, the site of cauterization and the number of exposures. Many of the catteries were taken from the Greeks, but Al-Zahrawi takes an independent line.

The last chapter of Al-Tasrif was dedicated to surgical instruments, introduced over 200 surgical tools, a staggering number by all standards. His illustrations of surgical instruments were the earliest intended for use in teaching and in methods of manufacturing them.

With its many drawings of surgical instruments, intended for the instruction of apprentices, its descriptions of formulas and medicinal preparations, and its lucid observations on surgical procedures, this treatise is perhaps the oldest of its kind. The majority of these instruments were devised, designed, and used by
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Zahrawi himself. He included illustrations of the surgical instruments. These figures probably were the first of their kind that survived till now and they constituted a unique contribution to the history of surgery. Any number of these does not appear in previous writings. These procedures and instruments may therefore be regarded as his own. Some of these instruments described by him are shown in the following diagrams.

Al-Zahrawi had a special interest in eyelid surgery. He gave sensible suggestions on the use of fine instruments, of which he had a wide variety. The third volume described detailed procedures of performing ophthalmic operations including “cataract”. He described surgical management of different pathological conditions i.e. Ectropion, Entropion, Trichiasis, ptosis and symblepharon etc. etc. of which some are as following ---

1-Blepharoplasty: Al-Zahrawi taught this procedure of great value and furnished detailed instructions regarding its use in 57 chapters of his treatise. These processes of eyelid was prepared by inserting a clove of garlic into a pocket of skin created for the purpose, and on the following day the garlic was removed before the suturing was commenced. His description of blepharoplasty, for example, resembles to a great extent what is being practiced nowadays "When superfluous lashes grow on the eyelid outside their natural place, below the natural lashes, and continue, they injure the eye and give rise to many kinds of disease, such as chronic lachrymation, dropping of the eyelids, and whiteness and opacity, eventually resulting in the destruction of the eye. The plastic operation on the eye is carried out in four ways: by the actual cautery; by caustic in the way mentioned above in the book on cauterization; by incision and suture; or with canes, as I shall describe.

You should place the patient’s head in your lap, then with your left hand, turn out the eyelid. Now if it thus becomes everted, good; otherwise introduce a threaded needle beneath the eyelid and pass the needle up; let that be near the hair itself. Then draw the thread up with the lid and invert the lid with a probe; then make an incision on the side of the lid below the superfluous lashes with the lancet, from the greater to the lesser angle. Then draw out the thread and put beneath the lid a small pad of cotton or linen; then mark with ink on the eyelid the shape of a myrtle leaf. The shape should be according to the amount you wish to raise the lid, and varies in different people. In some case you should cut away a fair
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amount in proportion to the ptosis. But in others a smaller incision is enough; all this in due proportion to the extent of the ptosis. Then with a scalpel incise over the two lines you have marked, beginning at the greater angle and going toward the lesser angle; and let one incision be close to the natural lashes, at a distance of about the breadth of a probe. Then introduce a hook into one angle of the skin and peel it all off; then join the edges with a needle and fine woolen thread. Wipe away the blood; and stick the ends of the threads to the eyebrow with adhesives, if you like; but if you do not. It does not matter. Then let the suture and the threads remain for about three or four days, then dress."

2- Entropion and Ectropion - In the treatment of Entropion, Al Zahrawi advised eversion of the eyelid with fingers or with a traction suture. An incision under the eyelashes from medial to lateral is then carried out so that the skin is separated from the lid margin. A leaf-shaped piece of eyelid skin is excised, and lash eversion is achieved as the defect is sutured primarily.

He realizes that it may be congenital or acquired, and he advised eversion and resection of a base-down triangular segment from the inner layers for lower lid laxity to treat cases of eye ectropion. And although the principle of his operation seems to be rather simple, and that is excision of a
triangle of tissues whose apex is directed towards the fornix, yet, it is one of the important basic principles of plastic and reconstructive surgery. With a simple addition, the operation he described is now known under the name of Kuhnt-Szymanowski operation (fig. 11).

“Put the patients head on your lap and mark upon the eyelid the shape of myrtle leaf, beginning near the lashes. Then apply cotton wool soaked in egg-white. Then heat a cautery of this form and burn over the shaped marked out, slowly with many small strokes till the whole surface of the skin marked out to the shape of the myrtle leaf is cauterized. The eyelid will contract, drawing the lashes away from the eye.

4-staphyloma-

He introduce a needle to the root of the uvea from the lower to the upper segment; then he introduce another needle threaded with a double thread means cutting the thread at the eye of the needle, leaving two ends to be used for ligaturing, from the region of the canthus major where you will perforate it; and leave the first needle in its place. Then cut the place of the doubling of the double threaded, and with it ligature that the part of excrescence around the needle and tie it well. Then remove the needle and to the eye wool moistened with egg-white; and leave till the thread falls away with the growth. Then treat the eye with fortifying dressing till the wound be healed. Sometimes the uvea is wound all around with a circle of material so that the prominence of the eye is greatly increased. Then he perforate it with a fine scalpel going to the depth of the eye; and an aluminous humor will flow out and the eye will shrink and return at once. Then the bandage till healed.
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Paulus (VI, 19, 20) is the immediate and hypopyon.

A fine scalpel (miqdah) is source for Albucasis sections on staphyloma mentioned but not further described. Page No. 248.

5-cauterization of a lacrimal fistula (translation)- “When you have treated a fistula in those ways mentioned in the sections on diseases, without success, it should be cauterized after this manner. Bid the patient put his head in your lap; and let an assistant hold his head in front of you without moving or stirring. The place cotton wool on his eyes dampened with egg-white or mucilage of psyllium seeds. Then heat a cautery, it should be hollow and in a shape like a fine tube, like an eagle’s quill, at the one end that is used as a cautery. And if you wish it may be perforated to the other extremity; or it can be solid like a probe. But this hollow instrument will be better for your operation. Then press on the fistula if it be open and get the matter out of it and wipe it away; or if it is not open, then open it. Then apply to it the cautery, which should be very hot, and press it in with your hand till it reaches the bone. While you are burning keep the hand away from the eye slightly towards the nasal side. And if you reach the bone at the first cauterization, good; if not, repeat the cauterization if necessary. Leave it a few days, then put on cotton wool with butter and treat with hygroscopic ointment till it heals. And should forty days have passed and it does not heal, apply a sharp corrosive ointment so as to expose the bone, and strip it as will be explained in the appropriate chapter.

Another method of cauterizing a fistula is that which some of the Ancients mentioned: apply yourself to the site of the fistula and incise it; then insert into the incision a fine funnel, this being the figure of it (fig 17), and pour into it a drachma of molten lead; and keep your hand on the funnel, holding it firm all the time, and do not let the patient move at all, lest the molten lead run into his eyes. Then you should put cotton wool soaked in egg-white or water upon the patient’s eye. For the lead cauterizes the site of the fistula acts as marvelous cure. If the fistula heals by cauterization and medication we have described, well and good; otherwise perforation of the nose will undoubtedly have to be undertaken to lead the fistula into the meatus of the nose, by the technique that will come in its own place. Albucasis appears to be the first to put forward a special cautery for curing this disorder. The Huntington figure agrees well with the text and indicates an instrument somewhat resembling a cork-borer; the fistula was followed along with this hollow tube cautery and an opening was thud bored out. He goes on to say that if the fistula is not cured by the simple operation, it will have to be opened into the nose. An alternative measure involved the use of funnels for pouring molten lead into the fistula.

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![Fig 17- Small funnel for pouring heated lead into fistula of the eye for cauterization. Top is from original Arabic manuscript (Vel. 2491) courtesy SüleymaniyeKütüphanesiMüdürlüğü. Bottom, from Sudhoff,Chirurgie, courtesy National Library of Medicine.](image-url)
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6- Cataract- Al-Zahrawi tells us, in the course of some of the more horrendous operations, to give the patient a rest from time to time, for instant in couching for cataracts. The method is to insert the couching needle, midah, into the white of the eye and press the point down. The illustrations show the needle as broadening out from the tip, like a spatula.

Then he describes new surgical instruments like the eye speculum with 3 hooks to hold up the upper eyelid.

These hooks are characterized by olivary ends to avoid damage to the eye. Then he proceeds to describe a pair of fine scissors, according to Spink and Lewis, was the first drawing of a true pair of scissors in the history of surgical literature.

SUMMARY

The few examples of illustrations of surgical instruments given here indicate that the Arabic manuscripts, in general, have preserved the original, oriental, artistic features of the drawings in a way that has been overlooked in Latin and vernacular versions of Al-Tasrif. In presenting his personal observations and original ideas on surgery late in life, Al-Zahrawi, for the most part, was inspired by a thorough acquaintance with Greek and Arabic medical literature supplemented by lifelong intelligent observation and experience. Through its descriptions and illustrations, the surgical treatise of Al-Zahrawi very likely played a significant role in the designing of improved surgical instruments in the Middle Ages. Also, the treatise no doubt promoted the development of improved surgical techniques in Islam and, through its translations, promoted these techniques to an even greater extent in the West, a fact that justifies the fame of this treatise as the highest expression of the development of surgery in Arabic Spain; a treatise whose influence continued to the Renaissance. It contributed in no small measure to the idea of equipping learned and well-trained surgeons with the best surgical tools and techniques of the time; moreover, it encouraged the invention of new instruments to meet differing circumstances and special
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conditions. These tools no doubt greatly facilitated the work of the surgeon.

Therefore, one should look at Al-Zahrawi’s multi-faceted contributions in the context of his time and, in particular, of the state of medical and surgical knowledge during the 11th century. A contextual appreciation of Al-Zahrawi’s contributions will certainly make us realize the freshness of his vision, the novelty and innovativeness of his surgical procedures and instruments, and his clinical far-sightedness. His legacy in neurology, transplant surgery, ophthalmology and gastroenterology will undoubtedly remain a magnificent chapter in the history of medicine and surgery.

CONCLUSION

Surgery has a long history. Surgeons and physicians’ inventions, innovations and experiments growth this field of medicine to the current stage. Albucasis was one of the great pioneers that raise the surgery by his findings in techniques, treatment approaches and invention of surgical instruments, to help surgeons in safe and comfort operations. Although some new surgical instruments are built and became patent until now, but this idea back to about 1000 years ago and presented by Albucasis. Remembering these instruments in this paper can induct the feel of surgery in around 1000 years ago to current medical practitioners.

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