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Al-Zahrawi (Albucasis) - A Father of Operative Plastic Surgery in Europe

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Abstract

Medicine has a great many "fathers" of the profession; Hippocrates in Ancient Greece, Sushruta in Ancient India, Hua Tuo in Ancient China, Guy de Chauliac and Ambroise Paré in France, Scotsman John Hunter, American William Stewart Halsted, and many, many others in between. One of those "in-between" was Abu al-Qasim Al-Zahrawi, who is also known in the west as "Albucasis. Al-Zahrawi has a great contribution in many surgical fields, including plastic surgery. He described many procedures and invented good number of surgical instruments.

Introduction

Al-Zahrawi, the Muslim physician is considered one of the great fathers and pioneers of surgery in Europe. We will focus here on his contributions into plastic surgery in particular as he was an innovator in this field.

He was born in Al-Zahraa, a little village near Cordoba in the Andalusia region (modern day Spain) in 936 AD. There is very little that remains from that old city which became ruins (Figure 1). Al-Zahrawi lived most of his life in Cordoba. It is also where he studied, taught and practiced medicine and surgery until shortly before his death in about 1013 AD (1). A remarkable lifespan and one that is not out of place in today's era.

There is no doubt that Al-Zahrawi was a remarkable man, one whose achievements were well ahead of his times. However, it is worth reading a little into the background and context in which he flourished and succeeded in. It has often been stated that the Muslim period of Spain's history

Figure 1: The ruins of Al-Zahraa city (Madina Azahra) near Cordoba

(Al-Andalus) was part of the Golden Age of Islamic civilisation (2). Harmony existed between Muslims, Jews and Christians as people from different faiths lived in

peace and tolerance (3); a situation almost unthinkable in various parts of Europe which suffered from rabid anti-Semitism and subjected Jews to vicious pogroms. Great advancements were made in different sciences (4). This reached the extent to which kings of Europe would send their children to Al-Andalus to be educated.

Under the Caliphate of Córdoba, Al-Andalus was a beacon of learning, and the city of Cordoba, the largest in Europe, became one of the leading cultural and economic centres throughout Mediterranean region, Europe, and the Islamic world. Al-Andalus became a major educational centre for Europe and the lands around the Mediterranean Sea as well as a conduit for culture and science between the Islamic and Christian worlds. This brought a degree of civilization to Europe that matched the heights of the Roman Empire and the Italian Renaissance. Al-Andalus became one of the great Muslim civilizations; reaching its summit with the Umayyad caliphate of Cordoba the tenth century; the era in which Al-Zahrawi lived (3).

Al-Zahrawi lived and served the Umayyad Caliph Al-Hakam II and the military ruler Al-Mansur (5). He ended up serving as a doctor for over 50 years. Unlike many doctors and hospitals in today's era, Al-Zahrawi insisted on seeing patients regardless of their financial status (5). By seeing a wide variety of patients every day and recording his treatment of them, he left behind a very valuable text of medical knowledge that he called Al-Tasrif. Its full name *At-Tasrif liman 'Ajiza 'an at-Ta'lif* (The Method of Medicine – for who cannot write a book) is a medical encyclopaedia consisting of 30 volumes compiled from medical data that Al-Zahrawi accumulated in a medical career that spanned five decades of teaching and medical practice. He apparently travelled very little but had wide experience in treating accident victims and war casualties. It was considered the first Text Book of Medicine with many illustrations (this was the standard text in European medical schools in the 12th century). It is remarkable that Al-Zahrawi wrote the book for his students and for those that would come after him – it wasn't a guide for the ruler, and he never expected financial benefits from it.

Al Tasrif's Last volume, number 30 (which consisted of over 188 chapters) was about surgery. It included over 200 illustrations of surgical instruments, most of which were invented by Al-Zahrawi himself, and explanations of their use. He was the first medical author to provide illustrations of instruments used in surgery; this act alone revolutionised the way in which surgery was taught. Al-Zahrawi was at odds to point out any good practitioner in surgery would have a strong understanding of anatomy which at the time was a controversial topic Islamically though a famous Muslim physician once said *"He who is engaged in the science of anatomy, increases his belief in God"* (6).

On wound management

Al-Zahrawi promoted the use of antiseptics in wounds. In (chapter 26) he explained the differences between primary and secondary wound closure and also the importance of wound Debridement before closure. He described four techniques to close the abdominal wall; two of which were quoted from Galen. The ones which he described in great detail were the Ant's head technique and the Cat's gut technique using absorbable suture taken from the cat's intestines.

On Haemostatsis

This involves stopping the vessels from bleeding, and was done by compressing the artery, by cauterization or by ligation (using silk known as Harir in Arabic or using Cat Gut made from Cat intestines) (7). This was long before the French Surgeon Ambroise Parr in 1552 spoke of it. Al-Zahrawi also used both Ligation or Cauterization of the temporal artery for the Treatment of Migraines and severe chronic headaches too (8).

On Hand Surgery

Al-Zahrawi described congenital hand deformities such as polydactyly and syndactyly. He reported the various presentations of polydactyly and the origin and composition (bone, flesh) of the extra finger. He also described the treatment for the various presentations of this anomaly: "*A superfluous finger, sometimes is all flesh, sometimes contains a bone, sometimes has a nail. That which is purely flesh is easily removed; you cut it off at the root with a broad scalpel. But the treatment of that which arises at the root of a finger is difficult; you should avoid amputating. In the case of one growing from the finger at a phalangeal joint, you should first cut through the flesh down to the bone with a circular incision; then saw the bone through, with one of the saws that suit the purpose; then dress it until it heals" (9).*

He identified syndactyly as a condition resulting from either a congenital disorder or a healing wound. He went to describe its treatment as: *"You have to cut the web away until the fingers are brought back to their original form; then interpose between them a pad or piece of material soaked in oil of roses to prevent them from rapidly joining together and to keep them apart"* (9,10).

In the last section of his volume "On Surgery," Al-Zahrawi described symptoms of fractures and dislocations

of different bony parts along with treatment and complications. (9,11).

On dislocation of the wrist, he mentioned the following technique of reduction: *"The carpus of the hand if often dislocated. The way of reducing the dislocation is to place the patient's wrist upon a board while an assistant stretches the hand and the doctor applies pressure on it until it goes back*". To reduce the fingers' dislocation, he recommended *"When one of the fingers is dislocated dorsally or ventrally, then extend the finger and thrust the dislocation with your thumb until it goes back"* (9).

He described the decreased grip strength as one of the symptoms of severed tendons, for which successful treatment was unfounded at the time: *"If the hand is slackened so that he is not able to grip anything; then you may know that the tendons are either severed or bruised. In this situation there is no method but to strengthen it by cauterization; this sometimes helps but sometimes is of no use at all"* (9) .

On Hypospadias and Genital Reconstruction

The work of Al-Zahrawi had significant impact in this field. He elucidated the treatment of imperforate urinary meatus, which involved creating a small opening in the meatal region of the glans penis (9): *"You should be quick and make a perforation with a fine scalpel, then put in the opening a lender leaden sound, tie it and keep it in for three or four days".* This was similar to Galen's suggestion of using a lead tube to keep the new urethra open. However, Al-Zahrawi used a solid fine probe instead. Hypospadias management involved making a new orifice in the middle of the glans penis and was narrated as: *"In those cases having a misplaced meatus, draw out his glans firmly and cut the end of the glans at the place of the meatus with a broad knife or sharp scalpel as if sharpening a pen, so that the middle of it protrudes like a glans penis and the opening falls in the middle as it should. And be aware of hemorrhage, which often happens; meet it with styptics and dress the wound until it heals"* (9,10) (Figure 2).

Figure 2: The knife Al-Zahrawi invented for the Hypospadias (Ref.18)

In contrast to the currently recommended surgical approach for management of penile fractures, Al-Zahrawi recommended conservative treatment by stabilizing the penis with a goose's neck (9,12): *"When man's organ is fractured, take a goose's larynx (tube) and introduce the penis into it; then let it be wrapped and bandaged and left for about three days until it is healed".*

Al-Zahrawi also described the diagnosis and treatment of both a Hypospadias and an Imperforate anus. Circumcision was another surgical procedure that was mentioned by Al-Zahrawi and its description was apt as it was not practiced by non-Muslims before. He wrote also about surgical techniques for circumcision, the instruments used (Figure 3) and how it was not advisable to use sedation as well as briefly describing complications.

Figure 3: The scissors Al-Zahrawi used for circumcision

On Oculoplastic and eyelid surgery

Al-Zahrawi was the first to introduce an eye speculum with 3 hooks and fine scissors to remove superfluous skin (Figure 4). He wrote about eyelid surgery and described the ectropion of both the upper and lower eyelids. In (chapter 11) of volume 30 of his book he noted various principles in that surgical field (1). He used ink to mark the incisions pre-operatively which became now as a routine standard procedure. Also he used the inverted V-shaped incision to treat the lower eyelid ectropion (9) (Figure 5).

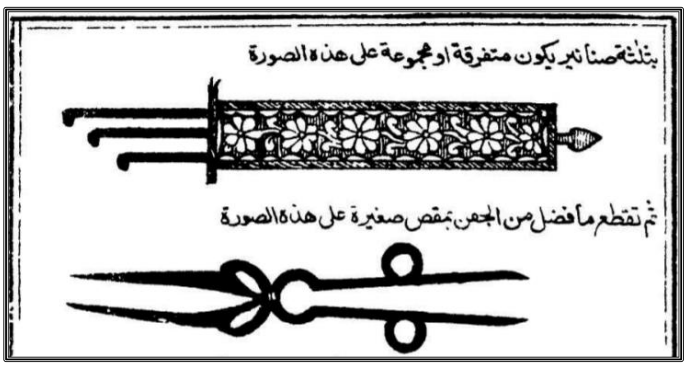

Figure 4: The hooks and scissors Al-Zahrawi used in eyelid surgery

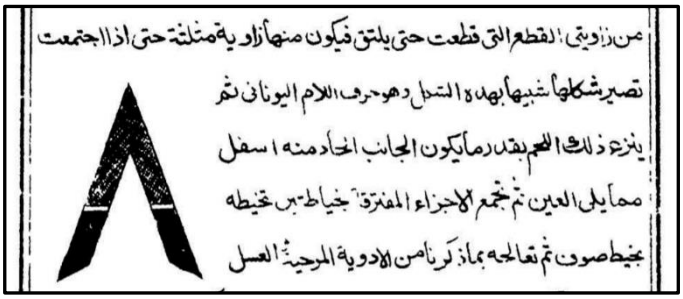

Figure 5:The incision Al-Zahrawi used for lower eyelid ectropion

On Gynecomastia and breast surgery

He explored this in Chapter 47 of his book Al-Tasrif and he described the surgical options to treat Gynecomastia and recommended the removal of the glandular tissue by a C-shaped incision for large breasts with excess skin and said *"make two incisions so that the edges join each other, then remove the skin and glandular tissue in between and suture the edges of the defect"*. Remarkably, this technique is still used for such Gynecomastia 1,000 years later (1).

On skin lesions and cancer conditions

Al-Zahrawi described the surgical option as the excision of benign warty skin lesions and dealing with planter warts. His work was unique and ahead of its time too. He recommended their wide excision and used breast cancer and thigh cancer as examples. He stated that if the tumour is large and at an advanced stage it would indicate that surgery is not a suitable option and once said "*I could not cure any patient with advanced cancer*" which underlined his wisdom and judgement that an "operate at all costs" mentality is not the right approach (13) and you should only try to perform surgery on operable cancers.

On Maxillofacial Surgery including congenital abnormalities

Al-Zahrawi described cleft lip as a fissure in the lip, more commonly identified in boys. For the treatment of cleft lip, he suggested cauterization (*kai*), which would heal with fibrosis and scarring and close the defect: *heat a small edged cautery, then quickly place it on the fissure till the burning has reached the depth of the lip. Then treat with wax plaster till healed" (9).*

He also discussed the management of some facial fracture, including nasal and mandibular fractures. He acknowledged the bony and cartilaginous parts of the nose and suggested the following for the management of nasal fractures: *"If one of the two upper parts is broken you should pass your little finger into the nostril and straighten out the fracture from inside, with your index and thumb of the other hand is outside. If the fracture is in the upper part of the nose and your finger does not reach, it should be evened by means of a probe with some thickness to it. You may pack the nose with fatty dressing and then apply externally a plaster of white flour and frank incense made in to a paste with egg-white; then put on top some soft towel, but do not bind up the nose at all" (9).*

He placed emphasis on comminuted nasal fractures and internal wounds: *"If the nasal bones are broken into small pieces or crushed, you should cut down upon them, remove them with a suitable instrument, and then suture the wound"*. He continued *"If there is an internal wound of the nose, you should dress it with pads and employ leaden tubes until it heals".*

The management of mandibular fractures was also described in his book (chapter 4/section 3) as: *"If it is merely an external fracture, not broken in two but sunken in wards, you should from within, push the concavity of the fracture gently outwards."* He continued *"If the break in the jaw is total, into two pieces, traction must be implored in a straight line on both sides, until it can be set, and if the alignment of the teeth is disturbed, you should tighten the teeth with golden or silver wires" (9).*

His principles of wound management involved primary suturing for fresh wounds and debriding healed margins prior to attempting surgical closure: *" If the wound is fresh and bleeding, bring the edges of the wound together with a suture, and dress it till it is healed. If the discontinuity has separated the edges, and both edges have healed, it is necessary to scrape both edges on the external skin till they bleed; then bring the edges together with a suture, and put over the powder a plaster of palm ointment, and leave it bandaged for two or three days*"(9).

Interestingly, Al-Zahrawi also wrote about Dental Surgery too; the distinction between the fields of dentistry and medicine were not as well pronounced at the time as they clearly are today. His writings included topics such as the wiring of loose teeth, the roots of broken teeth extraction, dental arches, dental instruments of the day and the correction of irregularities of non-aligned or deformed teeth (14). Furthermore, he also wrote about the replacement of loose teeth (implants) using part of the bone of the cow to replace a missing tooth (to create a crown or bridge) . Al-Zahrawi also described the way to abrade and shave the prominent teeth in order to improve its appearance. He described in great detail many instruments he used in the field of dental and maxillofacial surgery (Figure 6,7).

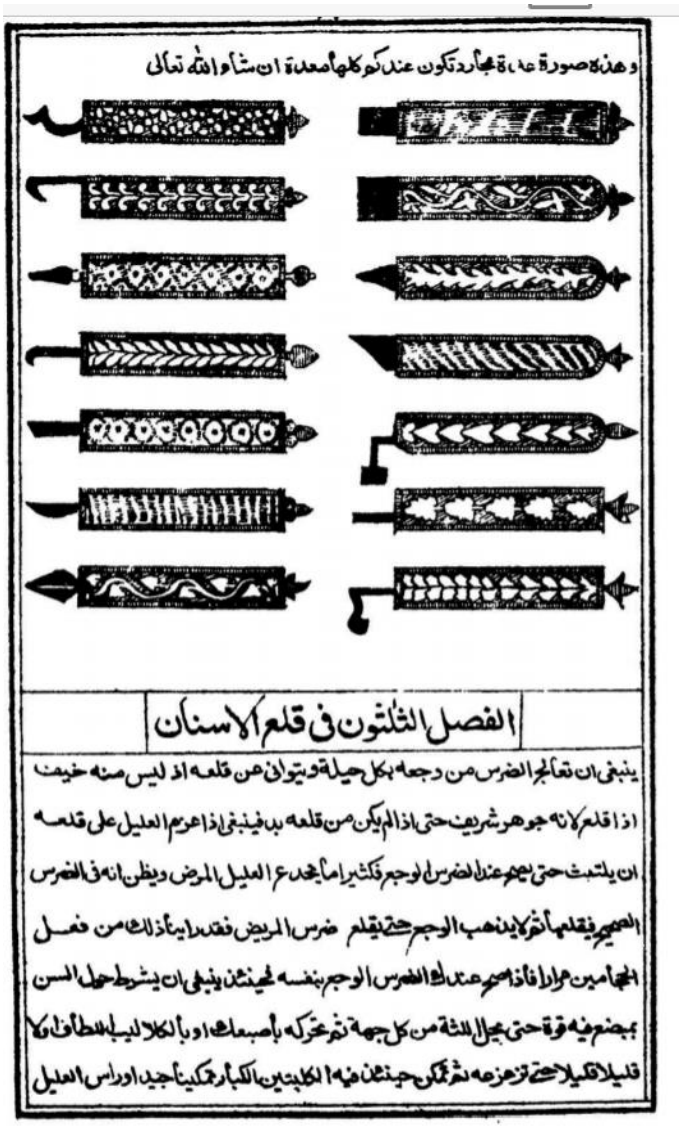

Figure 6: A page from Al-Tasrif showing the dental instruments (Ref. 18)

Figure 7: Instrument to remove broken teeth

All the instruments Al-Zahrawi used and described in his book (Al-Tasrif) have been replicated a few times by different museums, universities and people interested in Al-Zahrawi and his legacy (Figure 8).

Figure 8: Replicate of Al-Zahrawi surgical instruments. Sidi Mohamed University Fes (Morocco)

On observation of malpractice and ethics

It is important to touch on another field in which Al-Zahrawi excelled; the observation of malpractice and ethics. His observations were profound. Someone removed a tumour from the neck of a female patient which led to bleeding and her subsequent death. Another observation was the splintage of a leg with too tight plaster which led to compartment syndrome and then gangrene. The removal of a large bladder stone from a very elderly patient which led to complications due to his fragile state and subsequent death. The removal of advanced breast cancer which lead to bleeding and death bringing more harm than benefit. It was about knowing when not to operate as opposed to operating because "it is what was expected" and knowing the difference could prevent malpractice. Malpractice was not a concept understood at the time but the writings of Al-Zahrawi helped create a rudimentary understanding of best practice that went past the Hippocratic Oath. Al-Zahrawi would tell his students and other junior doctors *"Keep away from anything which may negatively affect your reputation in this life and the hereafter, for it is better for you and increases your ranks and pleases your lord".* He also wrote about the importance of positive doctor-patient relationships, referred to his medical students as his own children, and emphasized the importance of treating patients irrespective of social status. (9, 15).

Conclusion

Al-Zahrawi's book *Al-Tasrif* was translated into Latin by Gerard of Cremona in 1187 and remained the main reference for surgery in the universities of Italy and France for centuries. The French Surgeon Guy de Chauliac in his book *Great Surgery* completed in 1363 quoted *Al-Tasrif* over 200 times. Pietro Argallata in a 1531 Latin translation of Al-Tasrif said "*Without doubt, Albucasis (Al-Zahrawi) is the chief of all surgeons*" (16). Al-Zahrawi was clearly a surgeon well ahead of his time. Although I tried to focus mainly on the field of plastic surgery, his surgical achievements go beyond plastic surgery (17) and include general surgery, orthopaedic surgery, vascular surgery, urology, neurosurgery, ophthalmology, as well as obstetrics. These are all well documented and may need to be expanded on in a future article. His descriptions of the almost 200 surgical instruments (18) which fit their respective purpose was significant. Al-Zahrawi's findings and practices influenced healthcare practitioners in Europe for centuries to come and his impact is still felt in today's world (19).

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