



Abulcasis (936–1013): his work and contribution to orthopaedics

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Abstract

Aim of the study The purpose of this historic review is to summarize the life and work of Abulcasis (936–1013) and his contribution to surgery and orthopaedics.

Method We conducted an extensive search in libraries as well as online in PubMed and Google Scholar.

Results Abulcasis in his work combines the knowledge of ancient Greek and Roman physicians and surgeons with the extensive knowledge of Arabic medicine and pharmacology. He also pioneered surgical technique with the invention of numerous surgical instruments and with several revolutionary surgical techniques.

Conclusion Abulcasis made an impact with his medical writings in which he summarized the works of ancient Greek and Roman physicians like Hippocrates and Galen with the influence of medieval authors and the knowledge of the Arabic medicine and pharmacology. His descriptions and innovations in his work remained a work of reference in the West and East for many centuries to come.

Keywords Arab medicine · Abulcasis · Surgical instruments · Orthopaedic trauma · History of surgery

Introduction

Abu al-Qasim Khalaf ibn al-Abbas al-Zahrawi (936–1013), known as al-Zahrawi and with his latinized name Abulcasis (Fig. 1), was an Arab polymath, physician, surgeon, and chemist who lived in Al-Andalus, nowadays Spain, and he is considered a figure with multiple contributions in medicine and surgery of the Middle Ages. He is also considered the most influential surgeon of his time with a work summarized in a thirty-volume encyclopedia of medicine and surgery titled “Kitab al-Tasrif.” The volume on surgery of his work was translated in Latin and it was introduced in the Western Europe. It remained influential until the 1800s for its detailed descriptions of surgical procedures and surgical

instrumentation which remain popular until the modern era. Thus, Abulcasis became an influential surgeon both in the East and the West surgical tradition [1, 2].

The purpose of this review is to summarize the work of Abulcasis. For this reason, we went through the literature in PubMed and Google Scholar as well as a thorough search in libraries. In our review, we focus on the orthopaedic practice of Abulcasis and his treatment of fractures and orthopaedic conditions in general, as well as the influence he exerted on his successors.

The life of Abulcasis

Abulcasis was born in the city of Azahara, near Cordova, Andalusia, around the time of the city’s foundation in 936. He was a descendant from the tribe of Al-Ansar in Medina of the Arabian peninsula. He lived most of his life in Cordova. In Cordova, he studied, taught, and practiced medicine and surgery until shortly before his death in about 1013, two years after the sacking of Azahara. There are few original historic sources about his early life, except his public work. Our contemporary knowledge about him is derived from the work “On Andalusian Savants” by al-Humaydi who wrote the first

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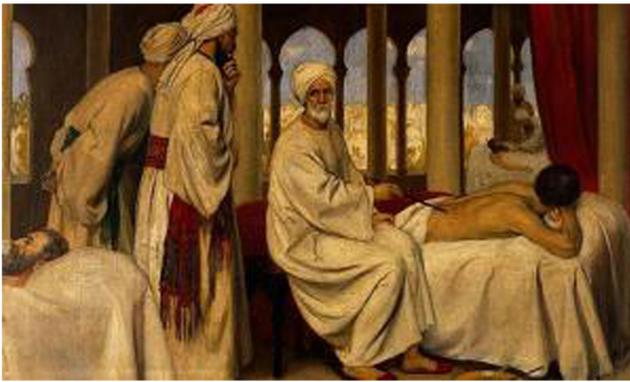


Fig. 1 Portrait of Abulcasis treating a patient

biography of Abulcasis, listing only his ancestry, his place of residence, and the date of his death [1, 2].

He became a court physician to the Andalusian caliph Al-Hakam II. He practiced with focus on surgery and he shared his vast knowledge and experience through his only work *At-Tasrif liman ‘Azija ‘an at-Ta’lif* (The Method of Medicine). *At-Tasrif* is a compendium of 30 treatises compiled from medical data that Az-Zahrawi accumulated in a medical career that spanned five decades of teaching and medical practice. His main contributions concern anatomy, physiology, and obstetrics [1–3].

Abulcasis and his contribution to surgery

The last and largest volume of *At-Tasrif*, “On Surgery,” was nothing less than the greatest achievement of medieval surgery. It was the first independent surgical treatise ever written and with it, medieval surgery reached its peak. This volume covers a wide range of surgical issues including cautery, the treatment of wounds, the extraction of arrows, and the setting of bones in simple and compound fractures. Az-Zahrawi also promoted the use of antiseptics in wounds and skin injuries; he devised sutures from animal intestines, silk, wool, and other substances; he also invented techniques to widen urinary passages and surgically explore body cavities [2, 3].

Abulcasis is the first to describe and implement the classic operation for cancer of the breast, lithotrities for bladder stones, and techniques for removing thyroid cysts. He describes and illustrates obstetrical forceps, but only recommends their use with deceased fetuses, and provides the first known description of the obstetric posture now known as “Walcher’s position.” *At-Tasrif* is also the first work to describe and depict surgical instruments, detailing over 200 of them, many of which Abulcasis invented himself. Many of these instruments, with modifications, are still in use today. He introduced his famous collection of over 200 surgical instruments such as scalpels, curettes, retractors, spoons, sounds, hooks, rods, and specula in the last volume of *At-Tasrif*. He included illustrations of the surgical instruments,

probably the first of their kind and a unique contribution to the history of surgery. A special medical instrument was used for cauterizing arteries. He also introduced the use of a ligature to control bleeding from arteries in lieu of cauterization, a scalpel called *Mibdla* used for incising and removing tumors, a saw named *Minshar* utilized for dead bones and amputation, a raspatory called *Mijrad* invented for scraping infected bones, a gouge for cutting pieces of infected bones, an osteotome named *Miqta* for cutting protruding fractured ends or dead bones, and wood blocks used under the bone to be stabilized and cut off safely. Also, a drill called *Mithqab* was invented for making holes, a bone lever to reduce fracture; a ball splint for fracture of the small bones of the hand; a special reduction table for reducing fractures of the humerus; a pestle for reducing shoulder dislocation; a catheter to treat urinary retention; a syringe named *Mihqan* used for washing the ear, vagina, rectum, and sinuses; a forcep called *Mishdakh* used to crush and extract the head of the fetus in obstructed delivery; a couching needle called *Miqdah* and a fine scalpel named *Barid* invented for extracting cataracts; a lancet called *Mibdah al-nash* used for venesection and cutting nasal polypi; a blade that could be grabbed between the fingers for use in nervous patients; forceps named *Jift* for the extraction of teeth; and cautery instruments named *Mikwa* used for a variety of problems from pain to hemorrhage [4, 5]. All these instruments are depicted in Fig. 2.

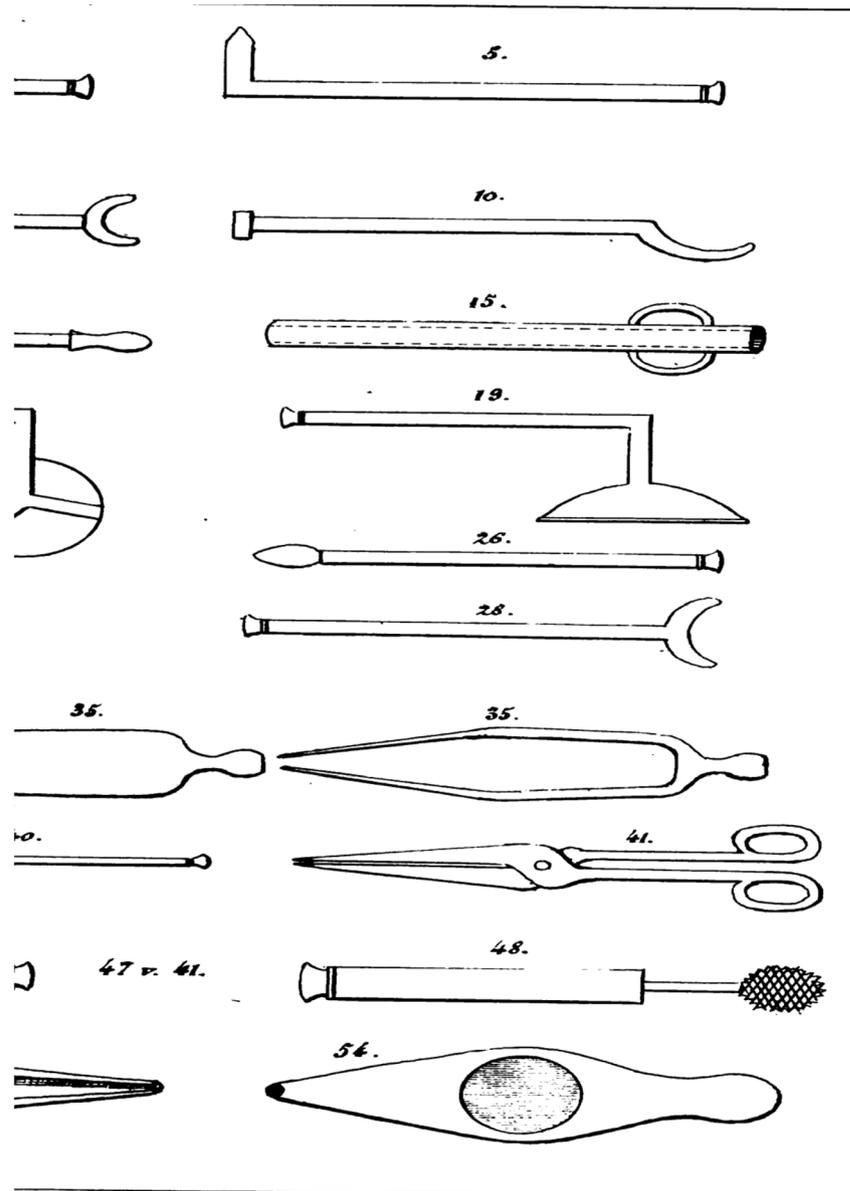
His use of cautery comprised a wide variety of applications in surgery in the treatment of abscesses, in the treatment of gangrene, and for amputations in the treatment of leprosy and its deformities, to reduce bleeding of arteries and to control pain in septic cases [4, 5]. He also proposes the use of cautery for the surgical removal of a wide variety of tumours [5].

With the reawakening of European interest in medical science during the late Middle Ages and the Renaissance, *At-Tasrif* quickly became a standard reference and it was translated into Latin. His medical writings were highly regarded in the West particularly after being translated by Gerard of Cremona, Rogerius Frugardi, Ronaldus Parmensis, and others. His surgical teachings were the most advanced in the Middle Ages until the thirteenth century. The arrangement of the work, its clear and specific language, and its lucid explanations all contributed to its popularity and great success. Abulcasis’ influence on the course of European surgical development was deep and long lasting. Guy de Chauliac, who brought back in Europe the systematic study of surgery, cites Az-Zahrawi more than 200 times [1, 2, 4].

Abulcasis on orthopedics

In the third part of his work, Abulcasis gives a detailed account of fracture treatment. He starts by explaining that the age of a patient suffering a fracture or a dislocation is of essence as well as the nutrition for the treatment. He also

Fig. 2 Depiction of surgical instruments invented by Abulcasis from the 1861 translation of his work



differentiates his treatment options in cases of simple or comminuted injuries. He describes reduction techniques manually or by means of ropes and the manual positioning in cases of multiple fracture sites. After that, he emphasizes, as his predecessors, the immobilization of the limb by means of bandages, clothing, and plaster as well as the non-weight-bearing principle. He gives a detailed description on dressing and casting techniques for immobilization with the use of plaster, swelling reduction, and pain relief. Of particular interest is his suggestion to open a window in the plaster for wound direct inspection [5].

He proposes the use of ointments and per os drugs for swelling reduction. He says that the Greek physicians prescribed the use of specific oils as ointments; he, like other Arab physicians like Avicenna, proposes the use of rose water

as ointment, egg-yolk, and several herbal extracts, both per os or as plasters on the swelling. Thus, he followed the Arab tradition and he enriched the Greek and Hippocratic medicine with his personal practice and experience and also with the Arab pharmacology [2, 5, 6].

In addition, he gives a detailed anatomic account of the upper and lower limb as well as the spine. He describes the bones and joints of the human body, muscle tendons, nerves, arteries, and veins for the limbs, the trunk, and the skull. His description is perhaps based on the works of Galen and the Alexandrian school of anatomy and physiology like his predecessors Oribasius and Paul of Aegina [5, 6].

As far as specific fractures are concerned, he described the fractures of the clavicle, the humerus, the radius and ulna, the wrist, the bones of the hand, the pelvis, the skull, and the spine

and fractures of the hip, the femur, the tibia, the patella, the tibia and fibula, the ankle, and the foot as well as fractures of the ribs and thorax. He proposes their reduction when necessary and describes the method of their immobilization but he advises against reduction that can damage arteries and jeopardize the limb [5]. Particularly, Abulcasis insists on the surgical removal of a broken patella of the knee in many pieces by means of the specialized instruments he had invented, mainly the bone forcep he invented [5] which is depicted in Fig. 3 and it is the first tool from above.

He also gave a detailed reference to the treatment of dislocations. His reduction techniques concern dislocations and immobilization of all major joints like the shoulder, elbow, wrist, digits, hip, knee, ankle, and foot in cases of anterior, posterior medial, and lateral dislocations. For reduction, he proposes the manual pulling or pulling through ropes or bandages. Of particular interest is his technique for the reduction of the anterior dislocation of the shoulder. He describes the reduction and pull of the humerus from the elbow joint with pressure anteroposteriorly and pull of the humerus laterally just like the Kocher manipulation described in the late nineteenth–early twentieth century [5].

As far as the treatment of hip pain and knee pain is concerned, Abulcasis proposed the use of cauterization for their

treatment. He described an anterior surgical approach for both joints and he proposed the application of cauterization on the joint capsule. Such a surgical technique is a clear reference to the treatment of bursitis, although the author describes his option for the treatment of sciatica. He also advocates extra caution to avoid destroying an artery or a nerve in the process [5]. He gives the same recommendation for the treatment of pain in the small joints of the foot [5].

His use of cauterization does not stop there; in the treatment of scoliosis, apart from the conservative treatment with ropes and the Hippocratic method, he proposed the use of cauterization in extreme cases of thoracolumbar deformity to detach the muscles of the back from the spine in order to reduce tension and reduce the spine malformation especially in children. Nevertheless, he advocates extra care in this process to avoid paralysis and vertebral destruction [5]. Abulcasis also describes his surgical technique for the removal of tumours and abscesses of tendons, and tumors of the joints. He advocated the use of cauterization like in other cases for the radical excision of tumors [5]. He also described the surgical removal of overnumbered fingers in infants according to the technique of Paul of Aegina [4, 5].

Discussion

Abulcasis, as far as his medical and surgical knowledge is concerned, was based heavily on his predecessors of the Greek and Roman schools of medicine. He used the anatomy and physiology of Galen and the Alexandrian school of medicine. He also was based on their orthopedic knowledge and the knowledge added by Oribasius and Paul of Aegina. Nevertheless, he was also influenced, as far as his chemistry and pharmacology are concerned, from the Arab tradition of medicine. His anti-inflammatory ointments add up his knowledge from the ancient Greeks who used oil extracts and he adds the Arabic method with egg yolk and herbal extracts for the swelling. He also, like Avicenna after him, proposes the use of per os drugs [1, 2, 6].

Perhaps the greatest contribution of Abulcasis came in the field of surgery. In his work, he summarized the knowledge accumulated by his predecessors but he did not stop there; he gave a detailed account of the therapeutic and technical modalities inherited by his predecessors but he also evolved them and in order to do so, he had to invent numerous surgical instruments. He describes these instruments in his work, with depictions he uses and they remain in use, in their basic form and principle, until nowadays [1–3].

Abulcasis' orthopedic practice is based on reduction of fractures and dislocations manually or by means of ropes according to previous descriptions. He describes dressing methods and immobilization techniques, he differentiates between closed and open injuries, and he describes the risk of a contaminated injury for complicating the outcome [1–3].

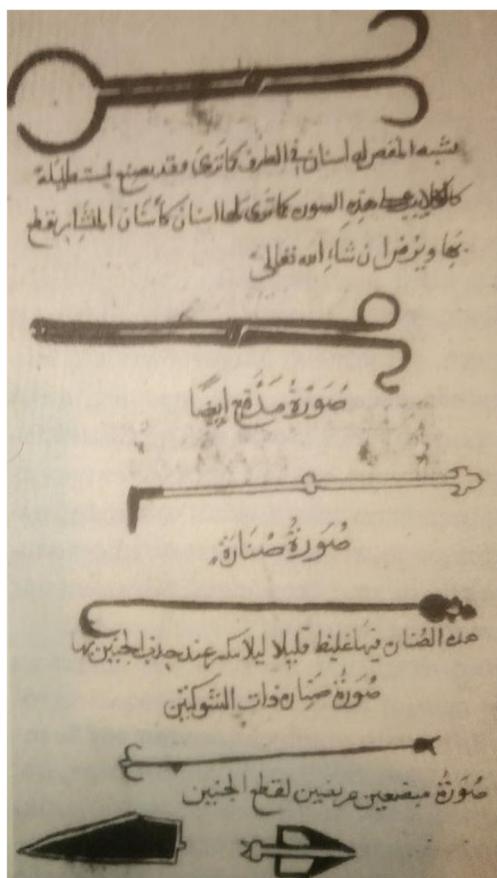


Fig. 3 Tools invented by Abulcasis. The first is his bone forcep

His work became a monument of surgical knowledge and technique for centuries and it was an essential teaching in the medical schools of East and West for at least 600 years [2, 3].

Conclusion

Abulcasis made an impact in the history of surgery with his multilevel work. He was based on his predecessors of the Greek and Roman school of medicine as well as the Arabic knowledge in pharmacology, but also he was a great innovator himself; he succeeded in inventing surgical instruments used in practice until nowadays in their most basic principle. His work remained influential in the Eastern and Western medical traditions for at least 600 years.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

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