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## **SURGERY IN ANCIENT TIMES**

by

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Preceptor: None

### **Abstract**

**In our modern world, invasive surgeries and organ transplantations are common: machines circulate and oxygenate blood and artificial organs have been developed. Taking a moment to contemplate these advances, it is easy to be impressed and even amazed at our accomplishments. However, if we take a further moment and consider our ancient ancestors, we may find that our amazement is considerably greater.**

**Imagine breaking into a human skull with no knowledge of anatomy, the existence of blood vessels and nerves, or the causes of infection; and doing so in the absence of anesthetic and painkillers. Yet, trepanation was a common procedure as early as 10 000 BC with evidence of a near 100% success rate. Further, the logic and efficacy of such a procedure is valid within our current medical knowledge and understanding. The practice of medicine in ancient times was based mainly on observations and beliefs, as a solid scientific understanding was being developed. I find this to be both fascinating and terrifying, especially as it applies to surgery. Thus, my topic focuses on the origins of surgery in ancient times.**

**The utilization of surgery to alleviate suffering and treat disease and wounds began with trepanation, with evidence of its use in many areas of the ancient world. In mesopotamia, surgical blades are compared to barber's blades and laws pertaining to surgery are imposed. The evidence of surgery in ancient Egypt is preserved in mummies, some of whom have fractures set with splints and sutures. In Greece, physicians performed surgical procedures as part of their duties. The Romans also performed surgeries, with many of their instruments being discovered in Pompeii. Further, ancient times saw the discovery of the importance of vessels in bleeding and their ligature. Ancient times even saw such "advanced" techniques as cataract surgery, the removal of bladder stones, the development of techniques for the closure of the abdominal wall and amputation. In fact, major developments in amputation did not occur for many centuries.**

The practice of surgery is routine and common in our modern society. Further, the surgical feats we have accomplished are both extensive and impressive; ranging from the removal of an appendix to the stopping of the heart and creation of new passages for blood flow or the opening of the skull to manipulate the brain. A moment of contemplation can easily allow one to be impressed and even amazed at what we have accomplished. However, if we take a further moment and consider our ancient ancestors, we may find that our amazement is considerably greater.

Imagine breaking into a human skull with no knowledge of anatomy, the existence of blood vessels and nerves, or the causes of infection; and doing so in the absence of anesthetic and analgesics. Yet, trepanation was a common procedure in ancient times. In addition, there is considerable evidence that a variety of surgical procedures were implemented. The practice of medicine in ancient times was necessarily based mainly on observations and beliefs, as a solid scientific understanding was being developed. This has the potential to be both fascinating and terrifying, especially as it applies to surgery.

The earliest evidence of a surgical procedure is found in skulls recovered from as long ago as 12,000 years (Majno 1975, 24). These skulls, with human-inflicted holes, reveal trepanation to be the first surgery. The procedure itself involves the removal of a portion of skull bone and was performed in many areas of the world; with many specimens being found in Peru and southern France (Majno 1975, 25-7). More astounding than simply that this procedure was performed, is its near 100% success rate. Studies examining the healing patterns of the bone adjacent to the site of removal indicate that not only was infection rare, but the person survived (Majno 1975, 27).

While we can only speculate as to the reasoning of our ancient ancestors in performing such a feat, blind to today's knowledge, there is some indication of their thoughts and intentions. To begin with, in many of the trepanned skulls the removed bone fragment is over a fracture (Majno 1975, 25). This suggests that the intent in removing a bone fragment was to "relieve" the effect of the fracture. The reason that we understand the efficacy of creating an outlet by which elevated intra-cranial pressures can be released following severe injury is rooted in scientific knowledge. We can ask ourselves how our primitive ancestors understood the same principles in the absence of our relatively modern knowledge. The value of simple observation and bravery in experimentation becomes apparent. Another theory possibly held is that a hole in the skull could provide an entry and exit for good and evil spirits, respectively; further, the Incas in Peru would wear the bone fragments as charms (Thompson 1942, 36).

An exploration of the various regions of the ancient world reveals additional delves into the human body. Of particular interest are the regions of Mesopotamia, Egypt, Greece, India, and the Roman Empire. Here, many theories were formed and many surgical procedures were put into practice. These procedures were as "advanced" as cataract

surgery, the removal of bladder stones, the development of techniques for the closure of the abdominal wall, and amputation (Majno, 1975, 311, 328, 363, Lascaratos and Voros 2000, 617).

In the ancient world, Mesopotamia occupied the region now claimed by Iraq. The Mesopotamian medical field as practiced by the Akkadians consisted of two types of practitioners: the ashipu (sorcerer) and asu (physician) (Majno 1975, 40). Again, the thoughts and beliefs of the time were foremost in the medical domain. A second manifestation of the beliefs of the time is what was recorded in written records. The description of the surgeon's knife (naglabu) could be expressed by combining the individual pictographs for barber and knife, thus producing the first relation between surgeons and barbers (Majno 1975, 40). However, beyond this discovery little was recorded of surgery except as it pertained to the law. King Hammurabi's code, engraved on a large stone, dictates that a physician is only responsible for doing harm if his treatment is achieved with surgery (Majno 1975, 43-5). In accordance with the importance the society placed on doing wrong, the concept of disease was inextricably associated with wrong-doing: one became ill if one performed a bad deed or was influenced by an extrinsic agent such as an evil spirit, and thus any injury or death could not possibly be attributed to the treatment received, unless the surgeon performed badly in surgery (Majno 1975, 43). The Sumerians of Mesopotamia held similar beliefs, leaving 150 000 legal documents and only two tablets relating to medicine (Majno 1975, 46).

The activities of the ancient Egyptians were revealed with the discovery of artifacts from their lives and afterlives. These people provided us with not only written records in the form of hieroglyphs and papyrus, but also actual specimens in the form of their dead (mummies). Two of these dead, who were living in time of the fifth 5<sup>th</sup> Dynasty (~ 2500 B.C.), were found to have received splints of bark fastened with bandages to treat fractured limbs (Majno 1975, 73). A third deceased Egyptian, living around 100 B.C. is the recipient of the first sutures; these, however, were received to close an embalming wound (Majno 1975, 93). There are also significant written records preserved on papyrus; from the Kahun, the first medical text from 1900 B.C., to the Smith and Ebers, the medical content is mainly prescriptions, spells, and diagnoses (Majno 1975, 73). It is of interest that there was a need for specialists of the eyes, teeth, and hidden diseases, but no surgeons (Majno 1975, 86). A simple explanation is that general practice encompassed the treatment of wounds and only a few, simple surgeries were actually performed.

In the era of Hippocrates, around 400 B.C., physicians were known as Iaotros (Majno 1975, 141). These physicians practiced both medicine and surgery as indistinguishable components of the medical art (Majno 1975, 147-150). The routine surgical procedures included techniques such as draining pus and trepanation (Majno 1975, 157, 166-9). Also practiced in this time was the technique of using probes to touch wounds, rather than having direct contact with the hands (Majno 1975, 167). The Greeks, not performing

amputations, documented their own approach to gangrene. When a limb underwent melasmos (blackening), the gangrene tissue was simply observed as it fell off. The only intervention that may have been undertaken was to remove the tissue that was certainly non-viable (below the level of black tissue) but not the underlying bone (Majno 1975, 191-2). It becomes evident that the physicians of the time did not have the knowledge that an amputation would be of benefit, nor the skill and knowledge necessary to perform such a procedure. They did what they were capable of: watching and documenting. This is essentially what characterized Hippocratic medicine: observation, documentation, and ideas constituted the birth of medical science, in the absence of experimentation and discovery. Thus, Greece's major contribution to the art of medicine was theories which remain evident in the language of medicine today; and some of which have even been corroborated by evidence.

In ancient India, surgery was quite an active pursuit. The need for surgeons (*shalyahara*) is evident in the translation of their title: *shalya* meaning a sword, arrow, or lance and *hara* meaning remover (Majno 1975, 267-8). This is reflective of the traditional weapon being the bow and arrow. It follows that the surgeons had many instruments designed specifically for the removal of arrows (Majno 1975, 274). Similarly to the cultures previously discussed, the medicine practiced was heavily based upon the beliefs held. The principles of medicine were integrated into a system known as Ayurveda, the knowledge or science of life, which was heavily based in tradition and beliefs. The practice of Ayurvedic medicine was documented mainly in two texts, written by Charaka and Sushruta. *Samhita*, a textbook of surgery authored by Sushruta, describes surgical procedures such as amputations, plastic surgery (especially of the ear and nose), and the removal of cataracts (Majno 1975, 262).

Our knowledge of Roman medicine comes primarily from the text *De Medicina* (on medicine), written by the encyclopedist Cornelius Celsus. Published in 1 A.D., it is the most significant medical document following the Hippocratic writings. The text contains descriptions of various surgical procedures, such as operations to remove goiters and bladder stones, as well as procedures to repair hernias and amputate limbs (Majno 1975, 353). In addition to this written record, the Romans have also left behind a variety of surgical instruments as an insight into their practice of medicine. The most valuable source of such instruments is the city of Pompeii; buried and preserved by the eruption of Mount Vesuvius in 79 A.D. Found in abundance in Pompeii were cylindrical medical kits, containing an assortment of probes and other instruments and likely carried by physicians. Also discovered were scalpels with dual cutting surfaces, separated by a central handle, screwed wound dilators, and an instrument resembling a trocar (Majno 1975, 357-360). A famous physician practicing around this time was Galen. He attended to wounded gladiators and implemented an experimental approach (Majno 1975, 398). He describes suturing muscle and managing hemorrhage by elevating the affected body

part, while compressing the injured vessel with his fingers before tying it with silk (Majno 1975, 403).

There is a long, stagnant time period following the progress of ancient surgery before the development of “modern” surgery. Prior to the first use of anesthesia in 1842, the only surgeries performed were amputations and the removal of growths (Wikipedia, Surgery). Further, amputations performed on a conscious patient were quite difficult. In addition to the challenges associated with the successful accomplishment of a new, rapidly evolving procedure, the surgeon was required to amputate quickly. The barber surgeons required only 3 to 4 minutes to amputate at the thigh (Sachs, Bojunga, and Encke 1999, 1088). It is important to note that the barber surgeons who were in practice from the 16<sup>th</sup> to the 18<sup>th</sup> century were considered to be distinct from physicians and of a lower class. Thus, the creation of the Royal College of Surgeons in 1800 improved the credibility and status of the profession; acknowledging surgery as the domain of physicians (Wikipedia, Surgery).

In addition to anesthesia, other crucial prerequisites to the success and advancement of surgery were the knowledge of anatomy and circulation. The “first” dissections took place in the 14<sup>th</sup> century, with the majority of developments in the field occurring in the 17<sup>th</sup> and 18<sup>th</sup> centuries (Wikipedia, History of Surgery). The most significant advancements in circulation did not occur until William Harvey described the circulation of blood, based on his experiments, in the 17<sup>th</sup> century: the blood flowed in two separate loops (pulmonary and systemic), blood flowed from the veins into the heart, facilitated by valves, and that the heart functioned as a pump (Wikipedia, William Harvey). In the absence of such imperative knowledge, it is logical that invasive surgeries did not rapidly evolve at an earlier time. Interestingly however, many ancient techniques were rediscovered following this newly acquired scientific knowledge and its application to surgery. These “ancient” techniques include vessel ligation, ear surgery, the use of tourniquets, and the drainage of fluids. One can consider the irony of how these ancient ideas were based on rational thought, and yet limited by the lack of a more comprehensive understanding.

An examination of the evolution of amputations can illustrate the rediscovery of ancient techniques. The technique of vessel ligation is credited to A. Pare, a surgeon who is said to have first implemented ligation to prevent bleeding in 1590 (Sachs, Bojunga, and Encke 1999, 1088). However, a look back at the medical developments occurring around 200 B.C. in Alexandria suggest vessel ligation was both understood and implemented much earlier (Majno 1975, 328). Alexandria was the base for two important physicians/surgeons, Herophilus and Erasistratus, who were involved in the scientific revolution of the time and place. The two physicians initiated the dissection of humans (even while they were still living), centuries before dissections became widely practiced (Majno 1975, 327-8). However, very little is preserved of their works following the destruction of the great library of Alexandria; what we know was learned from rare

descriptions in the writings of later physicians and historians. Nonetheless, Herophilus is credited with making the anatomical distinction between arteries and veins, as well as contributing many insights into the pulse. Erasistratus is said to have inferred the existence of capillaries without actually seeing them, as he believed that arteries and veins were connected (Harris 1973). In addition to these intriguing discoveries, there is evidence that in this time period vessel ligation was used in surgeries (Majno 1975, 328). Although the creator of the technique is uncertain, it very likely was either Herophilus or Erasistratus.

A second advance crucial to successful amputations was the tourniquet. Again, this advance is credited to Pare; with the first tourniquet being used for amputation by Morell, also a surgeon, in the battle of Besancon (Sachs, Bojunga, and Encke 1999, 1088). However, Hippocrates mentions tourniquets. In addition, the Greeks understood that a tourniquet could stop hemorrhage, with the risk of gangrene (Majno 1975, 152-3). In the writings of Scribonius Largus, the use of the tourniquet by Roman physicians was ridiculed. This stems from the lack of understanding of circulation of the time; it was thought that the tourniquet would actually squeeze the blood out of the compressed limb (Majno 1975, 404-5). It is probable that in ancient times, the scientific knowledge was simply lacking to successfully perform amputations. Nonetheless, it is astounding that some of the general principles were understood. Even more astounding is that these concepts were understood in the absence of a solid understanding of circulation.

It is essential that we have respect for our ancestors and their courageous entry into the field of surgery. As we strive to do now, our ancient ancestors did the best they could with what they had, which was a set of ideas, beliefs, and understandings. While many of their theories are identified as being wrong in light of our current medical understanding, there is often validity in their reasoning. For example, while the efficacy of relieving brain swelling is currently understood based on many scientific and medical principles, ancient people must have had their own reasons for trepanning a skull over a fracture. Perhaps their action was simply in response to the fact that it worked. Nonetheless, there is the indication that a thought process was followed, as we too construct ideas. Whether such reasoning is observational or evidence-based is irrelevant given the discrepancy in resources between current and ancient times. Thus, we are more similar to our ancestors than not.

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