

Cornelius Celsus—ancient encyclopedist, surgeon–scientist, or master of surgery?

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Abstract

Purpose The Roman nobleman Cornelius Celsus (25 BC–AD 50) wrote a general encyclopedia (*De Artibus*) dealing with several subjects, among which some had medical content (*De Medicina*), an eight-volume compendium, including two books about surgery (VII + VIII). It is the most significant medical document following the Hippocratic writings. In 1443, Pope Nicolas V rediscovered the work of Cornelius Celsus, despite it having been forgotten for several centuries, and it was the first medical and surgical book to be printed (AD 1478). Up until the nineteenth century, 60 editions were published in Latin as well as numerous translations in European languages, the last of which was a French translation in 1876. While Celsus' work is the best account of Roman medicine as practiced in the first century of the Christian era and its influence persisted until the nineteenth century, there is controversy as to whether Cornelius Celsus himself actually practiced as a surgeon or was only an encyclopedist who collected in the Latin language the medical knowledge available at that time.

Methods The detailed analysis of the surgical techniques described by Celsus, the modifications tailored to the findings, possible complications, detailed description of pre- and postsurgical activities, give the general impression that he himself practiced surgery at least within his family and among his dependents. In addition, his descriptions give a clear insight into the astonishingly high standard of surgical knowledge available at the time of Celsus.

Results His work thus reflects the state of knowledge of his time, which is why he also assumed the role of teacher and

scientist. As such, he meets the modern criteria addressed to a surgeon–scientist, who apart from the practical surgical activity, also had a role as teacher of surgery and scientist. Whether Cornelius Celsus had inaugurated a new surgical technique and was the first to describe that, and as such can be described as a master of surgery, cannot be corroborated. **Conclusion** Cornelius Celsus deserves a firm place in the history of surgery because with his publication *De Medicina*, Book VII + VIII, he has preserved Roman surgical knowledge in the first century of the Christian era and, thanks to the use of Latin in medicine and surgery, this continues to be retained up till the present day.

Keywords Cornelius Celsus · *De Medicina* · Roman medicine · Roman surgery

Introduction

Cornelius Celsus (25 BC–AD 50), a Roman nobleman, wrote a general encyclopedia (*De Artibus*) dealing with several subjects, among which some had medical content (*De Medicina*), an eight-volume compendium, including two books about surgery (VII + VIII). It is the most significant medical document following the Hippocratic writings [1]. Celsus adopted most of the Hippocratic theories and advanced them by presenting a complete description of etiology, clinical manifestations, and treatment of all diseases and illnesses [2]. His medical works provide information for a period up to 300 years before his time and, in particular, surgical knowledge of the Alexandrian School [3].

Before Rome conquered Greece in 146 BC, medicine and surgery had a low status in Italy for several reasons. For one thing, most of the doctors were Greeks whom the Romans despised. A Roman citizen considered a doctor's work beneath him [4].

Some Romans were willing, however, to write about the practice of healing, as Cornelius Celsus in his *De Medicina*,

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which provides an extensive picture of surgical art during the first century of the Christian era. In his books VII and VIII, there is evidence that surgery has made considerable progress since Hippocrates and the Alexandrian School [4].

Although almost forgotten for some centuries, Celsus was the first classical medical writer to appear in print (AD 1478) and his writings were highly valued during the Renaissance [5]. In 1443, Pope Nicolas V discovered a copy of the book in Milan and appreciated its content; thus, *De Medicina* regained its fame and value. Until the nineteenth century, there were more than 60 editions of the book published in Latin (Fig. 1) as well as numerous translations in European languages [3]. For example, in 1876 a French translation was published at a time when important medical and surgical journals that continue to the present day had already been founded, such as *The Lancet*, *Die Wiener Medizinische Wochenschrift*, and *Langenbeck's Archives of Surgery* [6].

The work of Celsus is commonly agreed to be the best we have of Roman medicine. Despite him being one of the greatest medical writers, it is a matter of controversy whether he ever practiced medicine himself [7, 8]. There are doubts whether Celsus was a true medical practitioner or just an encyclopedist gathering up the existing medical knowledge of his time [2].

Celsus was classed by Pliny the Elder (23–79 AD) among the men of letters and was ignored by contemporary practitioners who thought that a Roman could not know much medicine [7]. Celsus is not mentioned as having practiced in Rome and it is almost certain that he combined the practice of medicine with the study of science and literary pursuits. His practice was not general, but restricted to his friends and dependents [9].

Below, a few examples to highlight the high standard of surgery described in Celsus' *De Medicina*, Book VII and VIII. From the way Celsus described the various surgical techniques and which aspects had to be borne in mind before and after surgery, conclusions can be drawn as to whether Celsus himself actually practiced surgery.

Umbilical hernia

Of course the patient must be laid on his back, in order that the swelling, whether it be intestine or omentum, may slip back into the abdomen. But when the navel sac was then empty, some caught it between two little rods, and fastened the ends of the rods tightly together, so that it mortified there; some passed a needle doubly threaded through the base of the sac, then knotted the two ends of each thread on opposite sides, as is done also in staphyloma of the eye; from in this way that part beyond the ligatures mortifies. Some, in addition, before tying the ends also cut into the protrusion along a marked line and excised it:[...] [10, p 381].

Ideally, the ancient surgeons were known pass a doubly threaded needle through the sac's basal membrane and knot the threads' two ends on opposite sides, thus closing the fascial defect and separating the navel sac, which now protrudes noticeably from the abdominal surface. Subsequently, the protrusion is excised along a marked line, located directly above the suture.

Fig. 1 Printed version of Celsus' *De Medicina* from 1700



The basic principle remains unchanged: “The hernia sac is excised” and “closure of the fascial defect” [11] is consequent. Hence, the modern differs from the ancient method in not more than the “preservation of the umbilicus” [11]. But also today in very large umbilical hernias, the excision of the umbilicus is sometimes unavoidable.

It is more than astounding that the ancient Roman surgeons were in possession of so highly developed instruments, such as a curved needle with an eyelet. A burial object (Fig. 2) provides evidence for the fact that such an instrument has been used in surgery at the time of Cornelius Celsus [12]. The eyelet confirms that the burial object is likely to have been exactly one of those needles which Celsus would have employed for operating an umbilical hernia, as it can be equipped with two threads. Surgically also important, however, is the curved shape of the needle. Surgical needles today are also curved, since this shape facilitates suturing and the penetration into tissue layers. Ancient Roman surgeons obviously were aware of this fact and applied the knowledge and technology to surgery.

By Celsus’ time, surgery had developed, as Celsus himself wrote in his book VII in the foreword [10], with the contribution of Philoxenus in Egypt, Gorgias, Sostratus,



Fig. 2 Needle [Lat. acus] with eyelet from Ephesos, Asia, ca. 100 AD [12]

Heron, and the two Apollonii and Ammonius, the Alexandrians, and many other celebrated men, each found out something. Celsus also mentioned two other doctors who lived in Rome: Tryphon and Meges. However, Celsus’ innovations in the surgical treatment of hernia are numerous as no other physician before him described these types of surgery [3].

Abscess

Most abscesses require a linear incision; but in that termed panus, because it generally thins out the skin extremely, all the skin overlying the pus is to be cut away. But when the scalpel is used, care should always be taken that the incisions made are as few and as small as possible, but enough in number and extent to afford the necessary relief. For the larger cavities may at times have to be cut into rather widely even by two or three incisions, and cuts must be so made that the deepest part of the cavity gets a vent, lest any fluid should be left there to eat its way gradually into adjoining tissue, which was previously sound. [...] a little honey will be infused into the cavity to clean it, [...] [10, p 303].

Here, Celsus explains the process of opening a deep abscess. In these cases, the skin is also involved by the extreme thinning of the tissue and the involvement of vascular supply. Celsus advises the surgeon in most cases to make a linear incision and afterwards remove all the affected skin above the topmost of the pus cavity. However, Celsus instructs the surgeons to use the scalpel with care, lest they make too many and too large incisions. Rather they should be as small and few as possible, but enough in number and size to bring about the necessary relief. Furthermore, cuts should be made that create a vent for the deepest part of the cavity to ensure that there will not be any pus left. For disinfection, Celsus recommends infusion of honey into the abscess cavity.

Nowadays, the surgical treatment of abscesses follows almost exactly the same approach: “Drain (i.e. incision of) the abscess at the site of maximum tenderness”, namely at the top of the abscess cavity. “The common mistake is not to make the incision large enough”, just like Celsus said. “Cut away some skin, particularly any dead skin” and then “make sure that any more pus which forms can drain from the bottom of the cavity” [13] by the creation of a vent, “exitum” as Celsus called it. Thus, we can observe that not only the method stayed the same but also the mistakes that have been mentioned 2,000 years ago remain the same.

Even honey as a scientifically proven disinfectant for wounds and abscesses is made use of in medical everyday situations [14]. Celsus suggests using a scalpel to open and empty the abscess. From various findings, such as Fig. 3, it is clear that at the time of Celsus, highly developed scalpels were employed for operations [15]. Usually, these were made up of a copper handle and changeable iron blades. If the blades had grown blunt over time, the insufficient blade was swapped for a new, sharp one. Moreover, scalpel blades could differ from each other in size and shape depending on the demands of the operations [15]. Today, scalpels are obviously one of the most important surgical instruments and are still composed of a handle and a blade, which differs in size and form and can be removed and replaced easily.

Missile extraction

Missiles too, which have entered the body and become fixed within, are often very troublesome to extract. And some of the difficulties arise from their shape, some owing to the positions to which they have penetrated.[...] But if the missile is to be drawn back, the

wound should be enlarged with a scalpel, for then the missile comes away more easily, also less inflammation is caused; for this becomes more severe if the missile itself lacerates the tissues while being withdrawn.[...] In all such cases the wound should be laid open freely, and the retained object pulled out by forceps the way it entered [10, p 317].

Since the founding of a professional military medical corps by Emperor Augustus (27 BC–14 AD), Roman physicians gained experience and routine in treating war wounds, as there were numerous battles to be fought at that time [16]. The vast majority of such wounds were obviously caused by missiles and trajectories; hence, extraction of those was an intervention often performed by surgeons. The procedure itself with all of its possible difficulties is described by Celsus. A major difficulty can be the missile clinging to the interior of the body due to the depth and angle of penetration and/or the missile's shape. For the drawing back of the missile to be easier and to cause less inflammation, Celsus advises the surgeon to enlarge the wound with a scalpel. Celsus observed that just pulling out the missile will lacerate the tissue and consequently make the inflammation more severe. Ultimately, a forceps should be used to withdraw the missile from the enlarged wound (Figs. 4 and 5).

This approach is illustrated on a wall painting among the findings from Pompeii (Fig. 3). It pictures a scene from Vergil's Aeneid: the physician Iapyx is trying to remove an arrowhead from Aeneas' right thigh using a curved forceps (Fig. 4) [15].

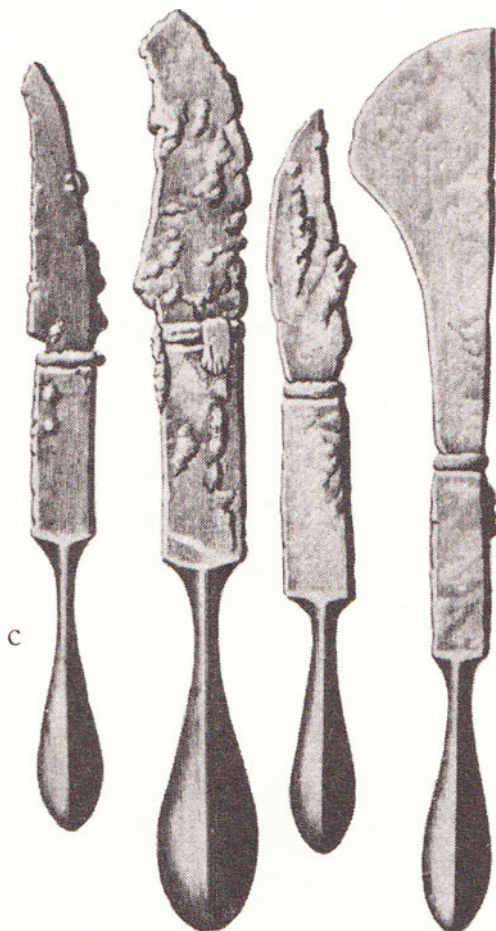


Fig. 3 Scalpels [Lat. sg. *scalpellus*] from the House of the Surgeon, Pompeii, 79 AD [15]



Fig. 4 Wall painting, Pompeii, 79 AD [15]

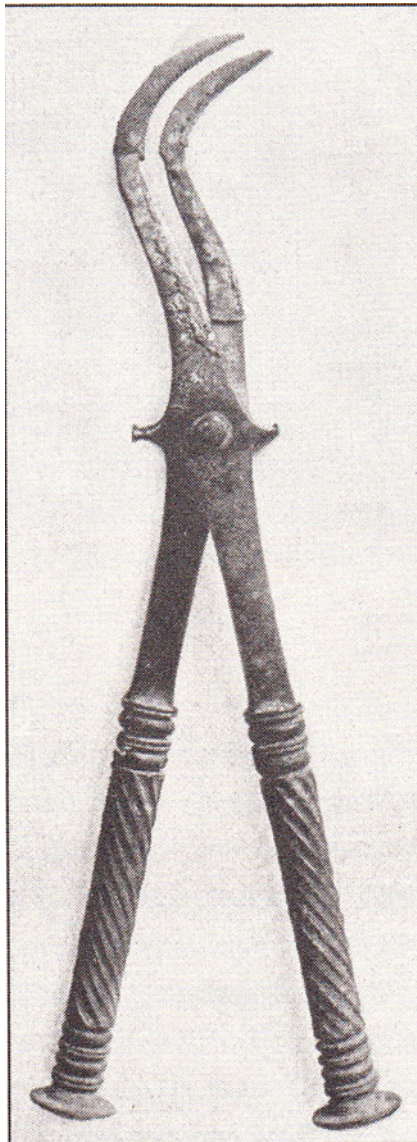


Fig. 5 Curved forceps [Lat. forfics] from the House of the Surgeon, Pompeii, 79 AD [15]

“The Roman method of extracting weapons and other foreign bodies was practically the same as our own.” [17]. Today infection and inflammation are still seen as major problems during and after the removal of weapons and foreign bodies. Enlargement of the wound by scalpel to avoid laceration is always a must [11]. For the withdrawal of the objects, highly similar instruments are in use.

Anal fistula

Special consideration is required in the case of those in the anus. In these, where a probe has been passed up to its end, the skin should be cut through, next through

this new orifice the probe is to be drawn out, followed by a linen thread which has been passed through the eye made for the purpose in the other end of the probe. Then the two ends of the linen thread are taken and knotted together so as to grip loosely the skin overlying the fistula. The linen thread should be made up of two or three strands of raw flax, twisted up so as to make one. Meanwhile the patient can do his business, walk, bathe, and take food as if in the best of health.[...] [10, p 313].

Here, Celsus describes the treatment of an anal fistula. Excising the whole fistula would lead to the extinction of the sphincter muscle, however, and thus incontinence [18]. Remarkable is that Roman surgeons must have known about these circumstances for they deliberately avoided excision, but instead inserted a probe up to the end of the fistula and afterwards incised the skin above the probe for enlargement. Then they pulled out the probe. This probe had an eyelet, to which a linen thread had been attached. The thread should be made up of two or three strands of raw flax twisted up to make one. Now the two ends of the thread were knotted together so as to grip loosely the skin overlying the fistula. Following this procedure the patients were able to carry out all of their tasks normally just like a healthy person (Fig. 6).

This approach for the treatment of anal fistulae passing through the sphincter muscle can be found in its original form under the name “seton technique” in modern surgery [19]. This technique features exactly the same proceedings even linen threads among other fabrics are still in use. The thread is also left in place for many months and the patients can follow their normal daily routine [18].

In a recent review article [20], it is pointed out that the age-old seton techniques are still practiced successfully in the treatment of complex fistulas in ano. The seton works by several mechanisms: (1) it helps in draining pus, (2) it stimulates fibrosis and acts as a marker of the fistula tract, and (3) the tight (cutting) seton promotes slower transaction of the external sphincter muscle as a result of pressure necrosis with minimal separation of the cut ends [20]. So conceptionally, a seton can be used as a marker or a divider. Both techniques are equally effective in eradicating the fistula [20].

Abdominal stab wounds and laparotomy

Sometimes the abdomen is penetrated by a stab of some sort, and it follows that intestines roll out. When this happens we must first examine whether they are uninjured, and then whether their proper colour persists.[...] The larger intestine can be sutured, not with

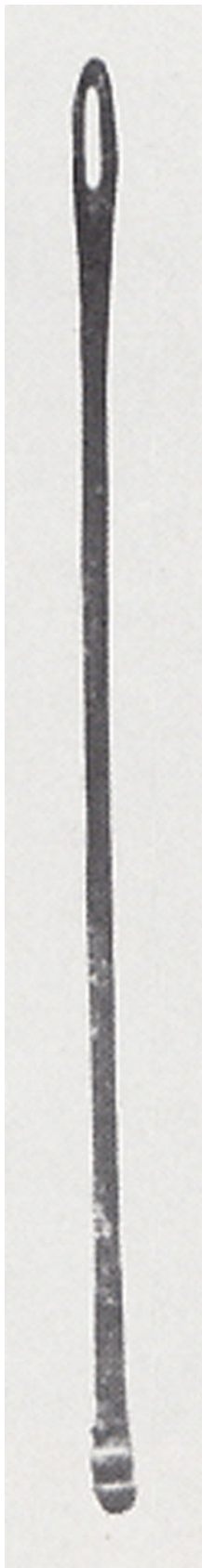


Fig. 6 Probe with eyelet [Lat. *specillo*] from Ephesos [12]

any certain assurance, but because a doubtful hope is preferable to certain despair; for occasionally it heals up. Then if either intestine is livid or pallid or black, in which case there is necessarily no sensation, all medical aid is vain.[...]The patient is to be laid on his back with his hips raised; and if the wound is too narrow for the intestines to be easily replaced, it is to be cut until sufficiently wide. If the intestines have already become too dry, they are to be bathed with water. [...] Next the assistant should gently separate the margins of the wound by means of his hands, or even by two hooks inserted into the inner membrane [...] Now stitching of the surface skin only or of the inner membrane only is not enough, but both must be stitched. And there must be two rows of stitches, set closer together than in other places, partly because they can be broken here more easily by the abdominal movement, [...] [10, p. 387]

By this extract, Celsus has not only introduced a method for curing stab wounds with prolapsed intestine but also some important basic principles of abdominal surgery.

First, he knew that the intestine's color can be used to judge the condition of the vascular supply of the intestine itself. For if the intestine was livid, pallid, or black, the blood supply was restricted in such a way that curing was impossible. Secondly, he knew that intestine tissue could be sutured. Thirdly, he knew that when intestine had prolapsed, aid should be provided most urgently, for, if exposed to external air, it would dry out. If very dry already, it could be laid into a bath of water. Fourthly, he knew that intestine tissue is very fragile and that hence the enlargement of the wound was necessary, in order to avoid damaging the intestine during reposition. Moreover, he knew that suturing an abdominal wound required thoroughness and assistance. Therefore, an assistant separated the margins of the wound by means of his hands or two hooks (Fig. 7).

Lastly, he knew that both the surface skin and the inner membrane of the abdominal wall had to be stitched and that the stitches had to be set closer together than in other places of the body because they could be broken more easily by the abdominal movement. For dressing the wound, Celsus listed 34 plasters and ointments in *De Medicina* [21].

Today, surgeons rely on the same basic principles, experiences, and recommendations that Celsus described for the closure of abdominal wounds and reposition of the prolapsed and injured intestine [15]. Another important issue discussed by Celsus is the excision of any part of the intestine or of the omentum that was "black". Unfortunately, no reference whatsoever can be



Fig. 7 Surgical hook [Lat. hamus] from Reims, province Gallia Belgica 3 [12]

found in any of the ancient texts concerning the anastomosis of the intestine, after having cut off the necrotic part [2].

Conclusion

The included examples demonstrate clearly, how precisely, thoroughly, well-reasoned and detailed Celsus described realization of surgical operations. In particular, he relates to special surgical individualities, gives pre- and postoperative instructions and often uses the emphatic “ego”, all of which give the reader the impression of reading the work of a highly experienced and active surgeon, although this practice was looked upon as beneath his dignity [7]. A critical examination of the works of Celsus shows how well versed Celsus was in surgery, so well that he must have watched very closely the operations of others, and perhaps occasionally operated himself. [17]. Moreover, he writes of patients he knew personally and attended even by night [7].

His writings show that he had a clinical knowledge of diseases and a considerable amount of medical experience [9]. Based on his own experience, he was able to propagate

surgical knowledge so well that it was preserved throughout centuries and generations after generations of surgeons could build up upon his heritage. Astoundingly, there is a great deal of conformity between ancient surgical approaches, methods, principles, techniques, nomenclature, even mistakes, and their modern equivalences. At the time of Celsus, many major operations were performed, and it is very instructive for doctors of the present day to learn that much that is considered modern was well understood by the ancients [9]. Celsus was the first to translate Greek medical terms into Latin, and the nomenclature which he began still persists [7]. He has brought forward examples to show that surgical practice was often along lines which might be approved of, even by modern surgery [17].

Celsus regarded surgery as an integral part of medicine and protested strongly against the tendency to separate them. By that time, surgery was considered a science, not a handicraft [4].

With his possibilities, Celsus has written a very fundamental surgical textbook, which could be considered as the basis of modern surgery in many aspects. Meinecke [22] called him an *artifex medicinae*, because he wrote *De Medicina* with independent judgment and he inaugurated a new medical nomenclature for the Latin language. Spivack [8] characterized him as knowledgeable, practicing physician with ethical standards that conformed surprisingly well to current practice. The compassionate and meticulous approach that he advocated may still serve as a model to the aspiring and practicing physician. “Any physician would be proud to call Celsus a colleague” [8].

Summarizing all facts and arguments, Cornelius Celsus seems to be not only a medical encyclopedist, collecting the medical and surgical knowledge of his time, but also an important practicing physician and surgeon with high ethical standards and own innovations. His work, *De Medicina*, was the first medical and surgical textbook printed, with influence on surgical generations until the nineteenth Century.

Celsus obviously met the requirements addressed to the modern day Surgeon–Scientist [23], because in addition to his practical activity as a surgeon, he also assumed the role of teacher and scientist and collected the medical and surgical knowledge available in his time.

However, whether he can be described as a master of surgery [24] who demonstrably invented a particular surgical technique cannot be proven. But that does not detract from his historic merits in the field of surgery since his publication *De Medicina*, Book VII and VIII, has had a significant influence on surgery right up to the nineteenth century and today gives us an insight into the state and possibilities of surgery in the Roman Empire in the first century of the Christian era. Therefore, Cornelius Celsus and his work *De Medicina*, Book VII and VIII, merits recognition by surgeons because his

publication helped preserve the surgical knowledge of his time and the nomenclature created by him persists up till the present day.

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Conflicts of interest None.

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