

Rise of aseptic
techniques and
standardization of the
sterilization of sutures
in...



The Rise of Aseptic Techniques and Standardization of the Sterilization of Sutures in America During the late 19th and early 20th century.

“ The birth of antiseptics had been heralded by Oliver Wendell Holmes in America ... but a mother could still exclaim when asked permission to operate, ‘ It’s easy to give consent but who’s going to pay for her funeral?’ ”[1]The suture before the practice of aseptic techniques was a source of the infection of either the wound or the surgical site. Since the development of proper sterilization procedure during the process of making sutures in the late nineteenth century. Sutures are an old technology that is used to treat a variety of injuries and surgical incisions. The safety of suture has changed over time as described in the quote above. It shows that in a time before standardized suture sterilization, the chances of a person recovering from surgery were as low as the success of the surgery. In this paper, I will explore the changes in sterilization techniques used by surgeons in the 1880s to the 1930s, and how those changes lead to standardized sterilization of sutures as a result of the rise of the aseptic technique in America.

Sutures have a very long history, it has been used by various cultures and civilizations throughout time. The suture we know today is safe to use and known to not contribute to the infection of a wound. Early in history, the materials used for sutures were not sterilized with aseptic techniques that came from the development of aseptic technique. The aseptic technique originated from the publication of Lord Joseph Lister’s *The Aseptic System: On a New Method of Treating Compound Fracture, Abscess, etc., with Observations on the Conditions of Suppuration*, which detailed on how the <https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

presence of germs in the atmosphere would cause infections. The history of the aseptic technique as it pertains to sutures comes from the realization that the material of the sutures and the way they were prepared led to differences in the way patients recovered after surgical procedures. This led to the discussion of developing a standardized method that was both effective and efficient to use in the large scale as the result of the change from the use of catgut to silk.

“ Not everyone was happy about carbolized catgut, especially when in 1881 Koch declared that carbolic acid in oil was not an effective antiseptic. At the same time Kocher of Berne discarded catgut altogether and sounded the first blasts of a campaign against catgut and in favour of silk, an argument that still continues through with but little virulence now. In 1885 Neuber of Kiel developed the principle of asepsis. This concept was advanced by Halsted when he introduced thin rubber gloves at the Johns Hopkins Hospital in 1890”[2]

Carbonization of catgut sutures is one of the early methods of sterilization. As a time when on the surgeons began to notice a difference in the way patients recovered after surgical procedures, depending on the material used. This created discussion among surgeons on the possibility of introducing a better sterilization technique that would decrease the incidences of infection in surgical sites, or if the material is the actual cause of the infection. Since the ideas of aseptic technique was a newly emerging idea at the end of the 19th century, surgeons were becoming aware of the relationship between germ theory and what that means for a surgeon to

reduce the incidence of infection. The principle of asepsis made its way through America and into the surgical theater of American surgeons.

Catgut sutures were a popular type of suture used by surgeons until there was a realization that the sutures were not as effective as previously thought. Catgut sutures are a type of suture made from the intestines of a sheep or goat. It is an absorbable suture that is able to be degraded by the body within a period of 90 days. “ Catgut, as obtained before a surgical operation, is a stiff, elastic and fat-holding material. Its preparation consists in the removal of the fat and in the thorough sterilization of its meshes, or rather an attempt at thorough sterilization.”[3]The catgut suture was difficult to work with for surgeons. The process to sterilize the material was difficult and consisted of a variety of methods. Due to the lack of standardized sterilization techniques, some physicians saw great success when using catgut sutures, while others saw a higher incidence of infection. This created a dialogue between surgeons across the country to look for a technique that could allow for the catgut suture to continue to be used, as it was a material that was more readily available than silk sutures. Thus dialogue between surgeons encouraged them to experiment with sterilization techniques that would eventually lead to a technique being used by a larger number of surgeons due to a variety of reasons, such as ease of use and less onsite preparation.

Silk sutures were another type of suture that was less popular during the 1890s, it was mostly due to the fact that the catgut suture was much more readily available. The silk suture is not an absorbable suture, like the catgut suture, meaning that the body doesn't break it down over time. Since it is <https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

not absorbable, the silk suture doesn't lose its tensile strength, unlike the catgut suture which loses its strength after seven days. Due to this property silk sutures were not really used by surgeons, only in cases in which the wound need to be placed under tensile pressure for long periods of time. "Silkworm gut is almost germ proof, and lasts indefinitely. I have extracted unchanged, a suture of this material seventeen months after its introduction into a wound. As a rule, it is well borne when used as a buried suture, but when its track is invaded by a germ infection, it acts as a foreign body." [4] The use of the silk sutures is mostly because of its ability to not be absorbed by the body. In the case of one patient of Dr. Weir, a patient was left with the silk suture in his patient to see what the effects of prolonged use. He found the suture did not change at all in the time that it was in the patient. He also noted that the skin around the wound did not show signs of infection as would be expected. The body usually would react to something like a suture as a foreign object. This property of silk sutures was extremely important, as the lack of infection even though it was placed in a long time ago, means that the silk material itself is not a material that is particularly favorable for bacteria to grow, thus making it practically aseptic. This information is important for the development of sterilization techniques to improve the quality of catgut since it is a more readily accessible material in comparison to silk.

Early sterilization techniques of catgut sutures relied on carbolic acid, which would remove the fat from the intestines of the goat or sheep. The methods of sterilization were not very effective at removing the bacteria that would go on to cause infection in the patient. " Any method of sterilizing catgut

must fulfill certain requirements. First, it must render the catgut sterile. It is not sufficient that it kills the various micrococci, colon bacillus, typhoid bacillus, and possibly anthrax. It must absolutely destroy every germ which may in any remote way produce infection. And it must do it every time. Sterility is the prime requisite. In addition, the physical characteristics of the catgut should not be impaired. It must be strong, elastic, absorbable.”[5]The sterility of the suture was obviously a major concern in the preparation of the catgut for surgery. The issue was that the methods used were not effective. This could have caused the catgut to fall from popularity since it was difficult to make a porous material like catgut to be sterile since the material made its self very hospitable to bacteria. Surgeons looked to other materials to take the place of catgut sutures, some looked to silver wire sutures, and other looked to silk sutures.

Many physicians switched to silk sutures, because of the properties of the material. They would use the same sterilization techniques but found greater ease of use and lower incidences of infections. “... Japanese twisted cable silk. It should be placed in water or in a one to forty carbolic acid solution, the day before it is intended to be used for if not thoroughly moistened, it is stiff and difficult to tie tightly. For several months past I have been in the habit of steeping it in a solution of Eucalyptol, Alcohol, Aqua dest [distilled water] which makes it perfectly antiseptic.”[6]The process of preparing silk sutures for use is similar to the process for catgut, they are both placed in carbolic acid to sanitize and soften the material. The silk suture, however, is more quickly prepared as the surgeon, J. H McIntyre describes, his own method of preparing silk sutures for use. In his article he describes using a

mixture he created himself as a way to ensure the sterilization of the suture. His experience is not much unlike other surgeons who at the time of the late 1880s , because there was no set standard for sterilization of the materials, many surgeons like Mc intyre, took it upon themselves to create a solution that was effective in sterilization and increased the ease of use of the material.

The lack of proper and truly sterile techniques for sterilization of sutures was very frustrating for surgeons, who often had to sterilize their own equipment to their own liking. Since there was no set standard for sterilization, surgeons had varying results after surgery with their patients. The difficulty of finding the perfect solutions and equipment to sterilize the sutures made it incredibly difficult for surgeons to provide proper medical care. “

Unfortunately the method is not simple. It requires rather complicated apparatus and a first class vacuum pump. The above is in the nature of a preliminary report. It is intended to experiment further in an effort to not only simplify the method but to secure wider applications if possible.”[7]The tools needed to properly sanitize the sutures were difficult to acquire, and maintain. Especially so for surgeons in rural areas. These struggles with sterilization encouraged surgeons to continue testing out solutions and equipment to find the proper combination of sutures that were able to meet their usage needs. The tried and tested methods of old, were not effective sterilizers, they would have many problems that would weaken the integrity of the suture, leading to a variety of conditions, and required further treatment for the patient.

There were many problems that come from poor sterilization of sutures. Infections and improperly healed wounds were often the results of the poor sterilization techniques used when sterilizing the sutures. “ It is easy to abuse catgut. A few sudden jerks by the surgical nurse, ostensibly for the purpose of testing the strand before handing it to the surgeon, is equivalent to the method adopted by the grocer in breaking the cord on his parcel —the result is, either the catgut fails completely, or else it is so weakened as to part under slight tension when in use. Prolonged soaking in aqueous solutions, especially if they be hot or even warm, causes a partial gelatinization and a material reduction in tensile strength.”[8]The catgut suture was a particularly fragile suture. When the suture was left for too long in the carbolic acid solution, the tensile strength would be lost. The loss of tensile strength often meant that the catgut suture would fail much more quickly compared to the normal amount of time to loss tensile strength, which is seven days. The lack of proper tensile strength would lead to other problems when the surgical wound would begin to heal. It could lead to infections and would make recovery very difficult for the patient. Because of the skill required to sterilize catgut sutures, it would lose its popularity as the suture of choice as it was difficult to maintain in the surgical suite of many surgeons. “ At the time [the 1890’s], catgut was and still is the predominant choice of most of the members of the visiting staff. However, members of the resident staff, who have had ample opportunity to use both materials and observe the results, have without exception, adopted the silk technique, and have enthusiastically continued its use since leaving the hospital.”[9]The downfall use of catgut could be attributed to the difficulty that was to prepare it and use it. The difficulty of using catgut led to many surgeons and <https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

hospitals to switch to silk sutures which were more easily prepared and did not lose its tensile strength. Although catgut became less popular, it doesn't mean that it was no longer used. It just was used more so for less long-term incisions, like surface level cuts, in which losing the tensile strength, and absorbable properties were more appropriate to use

Methods of sterilization continued to evolve to try to make catgut sutures as easy to use as silk sutures, and as sterile, if not more sterile than silk sutures. “ The Johnson & Johnson method's combine through continued disinfection or sterilization, not dependent upon any one feature, or upon the power of any antiseptic, or any one degree of heat, but upon the combination of the whole.”[10]Johnson & Johnson, an American company developed a method that combined previous methods and perfected a process that allowed for them to heat and store Catgut sutures in ways that would not destroy the material and allow for the material to be stored in sterile conditions for longer periods of time. This combined method helped set a standard for sterilization of sutures, which could allow the sutures to be already sterilized by people that were not the surgeon nor his assistants. This increased the efficiency of the hospitals and surgical suites. This push for better and more sterile materials by surgeons benefited both the surgeon and his patient. With better sterilization methods, patients were less likely to develop infections and recover from their surgeries more quickly. With the time saved form preparing sutures, surgeons were able to focus more on the treatment of the wounds, and treat more patients in less time.

Hospitals in the 19th century were undergoing a movement that prioritized efficiency and treatment of symptoms, not diseases. The efficiency movement saw a reduction in surgeries, as they were not very efficient and were time-consuming. The rise in cleanliness and the need for sterilization also came from the efficiency movement. " The shift in focus to efficiency comes from scientific management and Taylorism." [11] This efficiency movement is possibly a contributor to the motivations for the surgeons to find materials to use for sutures that would increase the efficiency of treatment, and reduce returning patients with infections at surgical sites, or wound sites. The resources that could be saved by having more effective treatment could be used on other patients, instead of using a large number of antibiotics, for example, to treat a surgical infection, if the infection could be prevented in the first place. The need for maintaining cleanliness could also extend to the sterilization of sutures. Since the sterilization of sutures and other surgical equipment is also a major source of hospital infections, which could be spread throughout a hospital if the hospital does not practice aseptic technique.

The concern with cleanliness and sterilization is in part due to the change in America's relationship with science. In the late 19th and early twentieth century saw the rise of scientific knowledge literacy among the average citizen. "...the entire hospital had become, by, 1925, quite actively and self-consciously based on science. Moreover, the definitions of what constituted as science was extremely broad. Just as the case for U. S society in general, within the hospital wall scientific ideals were perceived as having far-reaching importance, having the value that extended beyond the immediate

<https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

medical care of patients.”[12]The hospital and the American people both grew as a result of the increased scientific understanding, thus the change in how hospitals and people viewed and understood medical technologies in contexts outside healthcare. The acceptance of science in society encouraged medical technological advancement. The suture grew from the understanding of science, as suture its self is a technology and the process that make it sterile and usable in surgery came from the people who learned to accept germ theory. The scientific ideas that pushed the hospitals to find more effective ways to deal with increasing patients and creating more specialized positions within the hospital. Thus encouraging advancements in patient care and how patients learn about medical technologies.

The suture has a long history and is still being used today. The uses of sutures range from simple stitching up surface wounds to more complex surgeries, like holding muscle and ligatures together. The suture is a medical technology that saw the most growth as a medical technology in the late 19th and early 20th centuries. This was a time in which common people and health care professionals both learned about how to apply newly emerging scientific knowledge to current technology. The sutures saw the rise and fall of the popularity of suture material due to the changes in sterilization techniques used by surgeons in the 1850s to the 1920s, and how those changes lead to standardized sterilization of sutures because of aseptic technique in America. The sterilization techniques of sutures, had surgeons question if the ease of use silk sutures or abundance of catgut, was worth the treatment of their patients. The catgut was very readily available to be used but was a very difficult material to work with. The material needs to

<https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

sterilize, but there was no truly effective method. The early methods of sterilization would either leave the catgut suture weak and more likely to become loose or was ineffective leading to increased incidences of infection. Silk sutures gained popularity in the early 1900s but, there were some issues with the fact that the suture was not absorbable. Which, would require the surgeon to remove the suture from the patient, leading to more pain for the patient. The silk suture was sterilized in much the same way as the same way but the material properties of silk made it easier to sterilize, since silk was not as porous as catgut, thus a worse host for bacterial growth. With the technological and scientific improvement, a better and more effective sterilization technique allowed for catgut to become more popular in use. Thanks to this improvement in sterilization techniques and new standards on how effective sterilization needed to be, surgeons were able to use either type of material without having to sacrifice function over ease of preparation. Aseptic technique spread from the surgical room to other parts of the hospital. The efficiency movement in the hospital may have encouraged the surgeons to find better sterilization techniques and thus lead to advancements in surgery. It cannot be said for certain that the efficacy movement and germ theory are what encouraged surgeons and others to find more effective sterilization techniques for sutures. It may well have been other things that also influenced it, as I cannot say for certain that there was a tried and true method that led to standardized sterilization techniques. The American surgeons worked together with other surgeons from around the world and tested and collaborated with them to find a method that worked. That method that worked may well not have been the only method that worked. As today we now have much more effective methods of sterilization <https://assignbuster.com/rise-of-aseptic-techniques-and-standardization-of-the-sterilization-of-sutures-in-america/>

that does not mean that later on that today's methods will not be changed for other methods.

Bibliography

- Mackenzie, D 1973. " The History of Sutures." *Medical History* 17 (2): 158-168.
- Elkin, Daniel C. 1940. " Wound Infection a Comparison of Silk and Catgut Sutures." *Annals of Surgery* 112 (2): 280-283.

[1]Mackenzie, D. " The History of Sutures." *Medical History* . 17, no. 2, (1973): 166

[2]Mackenzie, D. " The History of Sutures." *Medical History*. 17, no. 2, (1973): 167

[3]Witherspoon, T. C. " Relative merits of catgut and silk in surgery" *St. Louis Medical and Surgical Journal*.(1894) series 2 vol. 17: 275

[4]Weir, Robert. F " *The Extraction of Too Long Retained Silk and Silkworm Gut Ligatures and Sutures.*" *Medical News* (1897): series 2 vol. 17: 428

[5]Hutchings, Willard H. " *NOTE ON CATGUT STERILIZATION.*" *Annals of Surgery* 54, no. 5 (1911): 694.

[6]McIntyre, J. H. " The Use of Silk Worm Gut Sutures" *St. Louis Medical and Surgical Journal*. 42, no. 1 (1882): 466

[7]Hutchings, Willard H. “ *NOTE ON CATGUT STERILIZATION.*” *Annals of Surgery* 54, no. 5 (1911): 695.

[8]Johnson & Johnson. “ *Handbook of Ligatures and Sutures: Historical Notes, Nature and Methods of Preparation, Sterilization, Testing and Handling, with Descriptive List of Prepared Ligatures and Sutures.*” Johnson & Johnson, 1926.: 61-62

[9]Elkin, Daniel C. “ *WOUND INFECTION. A COMPARISON OF SILK AND CATGUT SUTURES.*” *Annals of Surgery* 112, no. 2 (1940): 281

[10]Johnson & Johnson. “ *Handbook of Ligatures and Sutures: Historical Notes, Nature and Methods of Preparation, Sterilization, Testing and Handling, with Descriptive List of Prepared Ligatures and Sutures.*” Johnson & Johnson, 1926.: 27

[11]Luepke, Laura E. “ *Analytical Writing, Institutional Perspectives .*”
Lecture, Minneapolis, September 24, 2018.

[12]Howell, Joel D. “ *Physicians, Patients, and Medical Technology,*” Chapter 1 in *Technology in the Hospital: Transforming Patient Care in the Early Twentieth Century* (Baltimore: Johns Hopkins University Press, 1995): 5