Throughout history, many revolutions in the surgical sciences have occurred. Some are small, others more dominant, but always with the idea of improving the art and science of surgery. In this account we analyze the philosophical understanding of surgical revolutions.

**What is a Surgical Revolution Anyhow?**

Like any revolution, a surgical revolution represents change, most significantly in the knowledge and practice of surgery. A surgical revolution is the way that colleagues and patients accept new concepts in the evolution of the discipline. A revolution is the different manner by which society incorporates new ideas into the soul of the field. A revolution is a new paradigm demonstrated to be valid when caring for surgical patients.

**How do we Recognize a Surgical Revolution?**

Recognizing a surgical revolution is a simple process if the revolution is overwhelming in nature and scope, for instance, the introduction of antisepsis by Lister and asepsis by Volkman and von Bergman. These unique contributions are monumental examples of the perspicacity, determination and belief of the individuals behind them.
Just imagine how Lister must have felt while reaching the conclusion that antisepsis was fundamental in the art of curing patients undergoing even the simplest surgical procedures. Just analyze how others persisted to reach the point of no return in the acceptance of their discoveries.

On the other hand, it is difficult to recognize a revolution if it is minor or of diminished significance. We can allude, for example, to the introduction of new surgical instruments, new sutures, etc., which involved incremental change and, therefore, are not as important as the major revolutions that produced fundamental changes.

Are Surgical Revolutionaries Different?

Certainly, surgical revolutionaries have set the pace of the discipline or have opened up new and different roads for others to follow, have indeed contributed a great deal to the specialty, and are different from the day-to-day practitioner who has continued in the path set by others.

Surgical revolutionaries can come in the guises of Lister (antisepsis), Billroth (gastrointestinal surgery), McBurney (appendicitis), Kocher (thyroid surgery), Halsted (surgical residency and safe surgery), Cushing (safe brain surgery), Wangensteen (gastrointestinal physiological surgery), Blalock (relief of cyanotic heart disease), Lillehei (open heart surgery), and many others.

Surgical revolutionaries can also appear in the likes of Carrel (vascular anastomoses and organ transplantation), Forssman (cardiac catheterization), Huggins (hormonal effect in cancer), Graham (oral cholecystography and lung cancer), Gibbons (heart-lung machine), Murray (successful live-twin kidney transplant), and many others.

And surgical revolutionaries can also emerge as did DeBakey (arterial reconstruction, heart pump), Starzl (liver transplantation), Najarian (kidney transplants), Buchwald (surgical treatment of obesity and cholesterol), Shires (fluid management after trauma), and many others.

What are the Qualities of Surgical Revolutionaries?

Surgical revolutionaries have many qualities in common with surgical innovators and surgical discoverers. For instance, all three groups possess the
initiative to discover, innovate or to revolutionize; all three have the commitment and determination to succeed; all three have the perseverance to stay focused on the task at hand. Now, the differences among the three surface in their overall goals. The revolutionary is making a change, the innovator is introducing a modification to a well-known principle or technique, and the discoverer is initiating a completely new idea or way of treatment.

Surgical revolutionaries are leading the surgical community and establishing the pace of evolution in surgery. They are the leaders of the school of new advances in surgery. They are changing the way of practice!

**Is There a Way to Educate the New Surgical Revolutionaries?**

Of course there is, in the same way that we can educate surgical innovators and surgical discoverers. The main consideration will be to establish an effective curriculum which represents the ideas and principles of a surgical revolution. That is conceptualizing the knowledge and practice of surgery, knowing what is available and how deficiencies could be improved upon, how the concept of change, innovation or discovery could be taught in theory and practice.

Emerging surgical revolutionaries should receive a well-structured plan that permits them to recognize means to advance their ideas, their way of thinking, and opportunities to grow and prosper as well. The plan ideally would have deadlines for projects and accomplishments, and would define the best approach to testing the surgical principles and ideas learned, knowing that to revolutionize is to change the paradigms currently governing surgery.

**Can History Provide Long Lasting Examples of Surgical Revolutions?**

Definitely, the history of surgery provides us with a long list of examples that could very well support the learning of the principles associated with a surgical revolution. History would bring the principal actors, would discuss the roads they follow to create a surgical revolution, and would establish the characteristics of change previously addressed.
With the hindsight of history we can recognize patterns of progress, evaluate means of advancing a new cause, and in this way solidify details of innovative behavior that could lead to a surgical revolution.

Let’s take for example Owen Wangensteen (1898–1981), the great American surgeon-leader from a Minnesota farm who reached the heights of medical science at the University of Minnesota and beyond to the rest of the world. He introduced revolutionary concepts in stomach and bowel decompression, he considered second-look abdominal re-operation as a way to assess the progression of ovarian cancer, among other advances, and he developed a unique surgical school that was second to none in the world. The advanced Minnesota teacher and his disciples provided many surgical revolutions during his lifetime. Thus, history offers us the opportunity to learn from surgical revolutionaries such as Owen Wangensteen.

Are There Different Kinds of Surgical Revolutions?

Yes, indeed. Many surgical revolutions of different kinds exist. They can be major, minor, or in between. Major revolutions, for example, include the antiseptic surgical revolution, the aseptic surgical revolution, the x-ray revolution, the safe surgery revolution, the surgical residency revolution, the abdominal surgery revolution, and a cadre of unparalleled revolutions that excited the mind and stimulated the practice of surgical specialists.\(^3\)\(^5\) Well into the 20th century, other revolutions occupied the attention of surgical revolutionaries and common surgeons as well.

Minor revolutions in surgery include those instituted daily by the surgeon who changes a type of suture, uses a different incision, opens or closes the surgical wound differently, modifies excision of a tumor, or introduces a slew of other changes in operating rooms around the world.

Surgeons can be revolutionaries if they are amenable to improving the outcome of their patients by making a change that is effective and well thought out through any of the phases of the process — pre-, intra-, and post-operatively. All surgeons can be agents of change, can be revolutionaries, and can improve the practice of surgery.
Evaluating Surgical Revolutions Within the Context of Science and Technology

Connor\(^3\) from the National Museum of Health and Medicine at the Armed Forces Institute of Pathology in Washington, D.C., has advanced an interesting concept, namely that “the components of the surgical revolution are grounded in techniques and medical devices — innovations that, at heart, are technological.”\(^3\) A surgical revolution is then primarily technology-based according to Connor. Even though this assertion is highly suggestive and truthful in essence, other factors, such as the science behind revolutions, can be dominant and sometimes unique as the source of change. It is realistic to think that technology can drive science or, vice versa, that science can propel technological change. In the end, both of them, science and technology, participate in the surgical revolution, sometimes more one than the other, but both always present.

Basalla,\(^6\) a well respected technology expert, very astutely indicated that “technology is not the servant of science.” He proposed a middle way between science and technology, and I would add that both have a great deal to contribute to the advancement of a surgical revolution. Technology is art or craft and science is the systematic study of a specific event, phenomenon or function. Understanding science and technology will better define their roles in the development of a surgical revolution.

Science and technology, both, are at the core of determining whether surgical revolutions succeed or fail. In this sense, surgical revolutionaries need to promote and only accept superior science and technology. The more understood and tested the new methods and techniques applied to surgery, the more consistent and worthwhile the surgical revolution will be.

Are There New Surgical Revolutions Worth Considering Today?

Many advances in surgery have occurred in the past few decades. Aside from the revolutions of open heart surgery, transplantation, metabolic surgery, scan-guided surgical techniques, precise excision of brain-localized pathology and others, robotic surgery stands as one of the most recent important surgical revolutions.
Robotic surgery is a technological and scientific advance that has convinced the medical and lay community of its efficacy and practicality. Surgeons and patients alike have seen the immediate advantages of techniques utilizing robotic surgery. The outreach of these procedures is enormous, with demonstrated benefit for patients who remain hospitalized for shorter periods of time and return to work in a prompt and productive manner.

**Conclusion**

Surgical revolutions have appeared throughout history in an uneven manner and strictly based on the scientific and technological knowledge available at the time of the revolution. Great personalities behind a surgical revolution are evidently a significant force dealing with the completion of the event. A combination of commitment, perseverance and availability of science and technology are required elements in the road to a surgical revolution. Innovation and discovery can hasten the progress of a revolutionary event. The better understanding and complete analysis of surgical revolutions would allow our fellow surgeons to be more aware of the concepts and ideas and to participate in future revolutions.

**References**