

# Surgical Practices: Evolution, Modern Techniques and Future Trends

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## DESCRIPTION

Surgery, the medical specialty that involves manual and instrumental techniques to treat disease, injury, or deformity has a long and storied history. From its ancient beginnings to the cutting-edge procedures of today, surgical practices have evolved greatly, driven by advancements in technology, anesthesia and a deeper understanding of human anatomy and physiology.

### Evolution of surgical practices

Surgical practices date back thousands of years, with evidence of surgical procedures found in ancient Egypt, Greece and India. Early surgeries were often elementary and risky, performed without the benefits of anesthesia or antiseptic techniques. Amputations, trepanations (drilling into the skull), and other procedures were often performed with crude instruments and survival was far from guaranteed. The 19<sup>th</sup> century marked a turning point in the history of surgery. The introduction of anesthesia in the 1840s allowed surgeons to perform more complex and prolonged procedures without inflicting unbearable pain on patients. Shortly thereafter, the development of antiseptic techniques by Joseph Lister in the 1860s drastically reduced postoperative infections, making surgery a safer option for patients. These advancements set the stage for the rapid growth of surgical practices in the 20<sup>th</sup> century, leading to the development of specialized surgical fields such as cardiovascular surgery, neurosurgery and orthopedic surgery.

### Modern surgical techniques

Today, surgical practices are characterized by precision, safety and a focus on minimally invasive approaches. Several key techniques and technologies define modern surgery:

**Minimally invasive surgery:** Minimally Invasive Surgery (MIS) has revolutionized the field by allowing surgeons to perform complex procedures through small incisions, leading to reduced pain, shorter recovery times and less scarring. Techniques such as laparoscopy, in which a camera and instruments are inserted through small incisions, have become standard for many procedures,

including gallbladder removal, appendectomies and certain gynecological surgeries. Robotic-assisted surgery, a subset of MIS, has further enhanced surgical precision. Systems like the surgical system enable surgeons to control robotic arms with unparalleled accuracy, allowing for complex procedures to be performed with minimal invasiveness. Robotic surgery is now commonly used in urology, gynecology and cardiovascular surgery.

**Endoscopic surgery:** Endoscopy involves the use of an endoscope—a thin, flexible tube with a camera and light at the tip—to visualize the inside of the body and perform surgery without large incisions. Endoscopic techniques are widely used in gastrointestinal surgery, where they allow for the diagnosis and treatment of conditions such as ulcers, tumors and blockages. Endoscopic surgery offers numerous benefits, including reduced trauma to surrounding tissues, shorter hospital stays and quicker return to normal activities. Advances in endoscopic technology, such as high-definition imaging and miniaturized instruments, continue to expand the scope of procedures that can be performed using this technique.

**Image-guided surgery:** Image-Guided Surgery (IGS) leverages real-time imaging technologies, such as Computed Tomography (CT), Magnetic Resonance Imaging (MRI), and ultrasound, to guide surgical procedures with precision. This approach is particularly valuable in neurosurgery, where the ability to navigate the complex structures of the brain with millimeter accuracy is important. IGS also plays a key role in orthopedic surgery, where it is used to guide the placement of implants and correct deformities. The integration of imaging technologies with surgical navigation systems allows surgeons to plan procedures in advance and make adjustments during surgery based on real-time data.

### Future trends in surgical practices

As technology continues to advance, several emerging trends are poised to further transform surgical practices:

**Artificial Intelligence (AI) in surgery:** Artificial intelligence is beginning to make its mark in surgery, offering the potential to enhance decision-making, improve outcomes and personalize

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patient care. AI algorithms can analyze vast amounts of data to assist in preoperative planning, predict surgical risks and guide intraoperative decisions. In robotic surgery, AI could enable autonomous or semi-autonomous procedures, reducing the margin for human error and increasing precision.

**3D printing in surgery:** 3D printing technology is being increasingly used to create custom surgical instruments, implants and even anatomical models for preoperative planning. Surgeons can use 3D-printed models of a patient's anatomy to practice complex procedures, leading to better outcomes and reduced surgical times. Custom 3D-printed implants offer a perfect fit for individual patients, improving functionality and reducing the risk of complications.

**Regenerative medicine and tissue engineering:** Regenerative medicine and tissue engineering hold the capability of enabling surgeons to repair or replace damaged tissues and organs using a patient's own cells. Techniques such as stem cell therapy, gene editing and bio-printing are being explored to create functional tissues and organs that can be implanted into patients, potentially reducing the need for donor organs and improving the success of reconstructive surgeries.

**Telemedicine and remote surgery:** Telemedicine and remote surgery are set to expand access to surgical care, particularly in

underserved or remote areas. Through telemedicine, surgeons can consult with patients and other healthcare professionals from a distance, providing expertise where it is needed most. Remote surgery, powered by advanced robotics and real-time communication technologies, could allow expert surgeons to perform procedures on patients located anywhere in the world, bridging the gap between patients and specialized care.

## CONCLUSION

Surgical practices have come a long way from their ancient origins, evolving into a highly experienced field defined by precision, safety and innovation. Modern techniques such as minimally invasive surgery, endoscopy and image-guided surgery have transformed patient outcomes, reducing pain, recovery times and complications. As we look to the future, advancements in AI, 3D printing, regenerative medicine and telemedicine promise to further revolutionize the field, making surgery safer, more effective and more accessible than ever before. The continuous evolution of surgical practices ensures that patients will benefit from the best possible care, with each new development bringing us closer to the goal of optimal health and recovery.