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The history of the scalpel: From flint to zirconium-coated steel

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The surgical knife, one of the earliest surgical instruments, has evolved over 10 millennia. While the word "scalpel" derives from the Latin word "scallpellus," the physical instruments surgeons use today started out as flint and obsidian cutting implements during the Stone Age. As surgery developed into a profession, knives dedicated to specific uses also evolved. Barber-surgeons embellished their scalpels as part of the art of their craft. Later, surgeons prized speed and sharpness. Today's advances in scalpel technology include additional safety measures and gemstone and polymer coatings. The quintessential instrument of surgeons, the scalpel is the longstanding symbol of the discipline. Tracing the history of this tool reflects the evolution of surgery as a culture and as a profession.

Origins

Pinpointing a specific period of time when a cutting implement became the first surgical knife depends largely on perspective. Shells, razor-like leaves, bamboo shoots, and even fingernails may all be viewed as early surgical instruments. Thumbnails for newborn circumcisions, scarification via plant stems, and venesection with sharks' teeth served as the first examples of sharp tools for procedures on the human body.[1,2] John Kirkup, MB, BS—a retired surgeon and honorary curator of the Historical Instruments Collection at the Royal College of Surgeons of England—researched the history of surgical tools for more than 20 years.[3] According to Dr. Kirkup, circumcision with sharpened stones, one of the earliest recorded elective procedures, evolved into knives used for basic procedures.[4] Excavations of archaeological sites dating to the Paleolithic and Neolithic periods revealed knives for surgical use as early as 10,000–8,000 BC.[5] Blades were initially composed of flint, jade, and obsidian, with specific pieces chosen for their sharp edges. Fracture and flake techniques were then employed to refine these early blades into cutting instruments with desired characteristics, making these objects among the first human-refined tools.[6]

A particularly well-preserved prehistoric blade mounted onto a handle was found in 1991, preserved in ice near the Austrian-Italian border (see Figure 1). These types of tools were used for scarification, venesection, lancing, and circumcision. In fact, these instruments were still used for many of the same purposes by Alaska Native tribes well into the 19th century.[7] Evidence of obsidian blades used for more complex procedures such as craniotomies appeared around 4000 BC in prehistoric Anatolia, modern-day Turkey. Some archeological specimens are still sharp enough to incise skin.[8]

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Transition to modern scalpels

Metal blades replaced sharpened stone: first it was copper (3500 BC), followed by bronze and then iron (1400 BC). But it wasn't until 400 BC that the concept of a surgical knife was first described by Hippocrates.[9] He used the term "macairion," a smaller version of a Lacedaemonian sword called a "machaira," to describe the surgical tool. The machaira was a broad-cutting blade with a single edge and sharp point, containing the same essential features of the modern scalpel as defined by Stedman's Medical Dictionary: "A pointed knife with a convex edge."[10,11] In Rome, Galen and Celsus used an instrument with this shape—a small, sharp blade for specialized used for incision and drainage, tendon repairs, and vivisections (see Figure 2).

2

The Romans named their version of this tool the "scallpellus," the diminutive form of the word scalper ("incisor" or "cutter").[12] With the collapse of the Roman Empire, surgical innovation flourished in the Islamic Golden Age. Albucasis (Abū al-Qāsim Khalaf ibn al-'Abbās al-Zahrāwī, 936–1013) in the Caliphate of Córdoba (modern Spain) used a scalpel that held a retractable blade.[13,14] Surgical instruments became even more varied and specialized with the Renaissance in the 14th and 15th centuries. Embellishments to the scalpel included fixed and folding blades and specialized tips, such as lancets, bistouries, and double-edged blades called catlins.

Barbers working during the Renaissance period, including fathers of modern surgery such as Guy de Chauliac and Ambroise Paré, used ornamented scalpels with artistic flourishes that enjoyed wide popularity for several hundred years.[15] The requirements of antisepsis and asepsis in the late 19th century subjected instruments to caustic chemicals and pressurized steam sterilization, so nonmetallic decorations became obsolete (see Figures 3 and 4).

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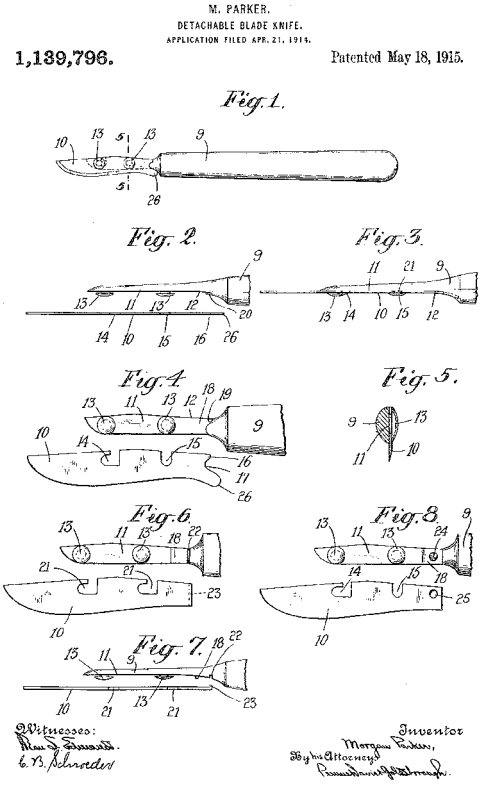
Disposable scalpels

King C. Gillette founded the American Safety Razor Company (later the Gillette Safety Razor Company) in 1901 to produce and market a handle-and-frame device that held disposable razors. John Murphy, MD, FACS, a Chicago, IL, surgeon and one of the founders of the ACS, adapted Gillette's razors into a tool that could be used when performing surgical operations. Dr. Murphy's version featured interchangeable blades, although it required extra instruments to complete a blade exchange.[16]

In 1914, Morgan Parker, a 22-year-old engineer, invented the two-piece blade-and-handle medical scalpel that is used in ORs today.[10] It allowed rapid mass-produced, sharp blades to be used and exchanged on standard reusable handles. According to legend, Mr. Parker's uncle, a New York, NY, surgeon, became impatient with the cumbersome process of the blade exchange in his busy practice. A glance at Mr. Parker's elegant solution reveals its genius (see Figure 5). He stated the following in his original patent application:

For the purpose of securing the blade to the handle, headed studs are preferably provided on the handle adapted to co-act with suitable slots in the blade. When such headed studs and slot are employed, the blade may be readily secured upon the handle and when in position will be held so rigidly as to preclude the possibility of movement relative to the handle.[17]


M. PARKER.
DETACHABLE BLADE KNIFE.
APPLICATION FILED APR. 21, 1914.
1,139,796. Patented May 18, 1915.
Fig. 1.
Fig. 2.
Fig. 3.
Fig. 4.
Fig. 5.
Fig. 6.
Fig. 8.
Fig. 7.
Witnesses:
Inventor
By his Attorneys

When Mr. Parker presented his scalpel at the ACS Clinical Congress of 1915 in Boston, MA, its reception encouraged him to take it to production. Mr. Parker, an engineer but not a businessman, sought a partner. The first name listed alphabetically in the phone book under "medical suppliers" was C.R. Bard. Together, they formed the Bard-Parker Company, which became one of the iconic names in surgery. They developed cold sterilization to avoid superheating, which killed microorganisms, but also dulled the blade. The rib-back handle replaced those that bore the paired studs in 1936 in order to ensure one-way fitment between the blade and handle.

The numbering system of blades and handles is arbitrary, a fact that likely confirms the suspicions of generations of surgical interns. As part of the Bard-Parker marketing scheme, each new blade and handle design was given a new number and occasionally a letter that denoted a "new and improved" model (for example, #15C).[18] As a result, a given number has no relation to size, shape, sharpness, or even a place in the product timeline.

Modern additions

In the modern era, hardened alloys, such as 316L and 440C stainless steel, replaced carbon steel in most settings. Stainless steel had superior corrosion resistance, and reusable handles benefited most from the high chromium content of stainless steel. Retracting blades, a concept dating to the time of Albucasis of the 10th century, became an increasingly common safety feature. Nickel and chromium plating became less common. Recent technological improvements include zirconium nitride, diamond, and polymer coatings that enhance the cutting edge. For all the improvements evident in contemporary surgical technology, electron microscopic images actually confirm that the edge of Neolithic obsidian blades exceed today's steel scalpels in sharpness.[19]

Conclusion

The scalpel, since its first use as a medical knife by the Romans, has been a symbol of the surgeon. Its evolution in many ways mirrors the progress of those wielding it. Prehistoric humans used stone tools occasionally for medical uses. The Greeks and Romans advanced both knowledge and skill while creating dedicated surgical knives. The barber-surgeons refined techniques as they refined the instruments used for them. Asepsis mandated sweeping changes in both scalpel and surgical practice. Today, the modern surgeon relies on a wide array of technologically advanced and ever-changing equipment, yet the operation still begins with the scalpel, the profession's oldest instrument.

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Legends

1. Flint dagger of Ötzi the Ice Man. Image © South Tyrol Museum of Archaeology/Harald Wisthaler, Bolzano, Italy.
2. Example of a Roman scallpellus and similar instruments. Courtesy of Historical Collections & Services, Claude Moore Health Sciences Library, University of Virginia, Charlottesville.
3. Surgical set from the American Revolutionary War. Displayed in the Smithsonian National Museum of American History, the set includes wood and iron handles and required routine sharpening of the blades.
4. Detachable blades from circa 1900. Courtesy of the Royal College of Physicians and Surgeons of Glasgow, Scotland.
5. Morgan Parker's original patent. Source: United States Patent and Trademark Office, *uspto.gov.*