



SURGICAL INSTRUMENTATION

SECOND
EDITION



Nancymarie Phillips

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RN, PhD, BA, BSN, MEd, RNFA, CNOR(E)



Australia • Brazil • Mexico • Singapore • United Kingdom • United States

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CONTENTS



PREFACE	viii	CHAPTER 3 CATEGORIES OF SURGICAL INSTRUMENTATION	23
CHAPTER 1 HISTORY OF SURGICAL INSTRUMENTATION	1	Clamps	23
Historic Surgical Instrumentation	1	Basic Hemostatic Clamps	24
Ritual and Magic	2	Grasping Forceps	39
CHAPTER 2 ANATOMY OF SURGICAL INSTRUMENTATION	5	Ring-Handled Grasping Forceps	39
Evolution of Modern Surgical Instrumentation	5	Non-Ring-Handled Grasping Forceps	41
Anatomy of a Surgical Instrument	6	Dissection Instrumentation	48
Handle Styles	6	Sharp Dissection Instrumentation	48
Joint Styles	11	Debulking	58
Tip and Jaw Styles: Sharp Dissection	11	Manual Debulking	58
Tip and Jaw Styles: Clamping, Occluding, and Grasping	12	Probes and Dilators	61
Tip Styles: Blunt Dissection	15	Measurement and Expansion	62
Categories of Surgical Instruments	16	Evacuation and Instillation Instrumentation	66
How Surgical Instruments Are Named	17	Evacuation Instrumentation	66
Materials Used in the Manufacture of Surgical Instrumentation	17	Injection and Irrigation Devices	68
Metallics	17	Retraction and Exposure	68
Steel	17	Retractors	68
Copper	18	Approximation and Closure Instrumentation	77
Titanium	18	Suturing Instrumentation	77
Silver	19	Anesthesia Intubation Instruments	83
Surface Finishes of Metallic Surgical Instruments ..	19	CHAPTER 4 CONSIDERATIONS FOR INSTRUMENT SET ASSEMBLY	86
Inspection and Quality Control of Metallic Surgical Instruments	19	Instrument Containers and Trays	89
Scissors	19	Perforated Trays	89
Clamps, Needle Holders, and Graspers	20	Closed Rigid Containers	90
Forceps	20	Specialty Trays	91
Retractors	20	Assembly of Instrument Sets	91
Maintenance	21	Determining Instrument Set Contents	91
Cleaning and Lubrication	21	Counts and Accountability	92
Ultrasonic Cleansing	21	Overview of Processing Options	93
CHAPTER 3 CATEGORIES OF SURGICAL INSTRUMENTATION	23	CHAPTER 5 SOFT TISSUE FOUNDATION SETS	95
Clamps	23	Short Foundation Set	96
Basic Hemostatic Clamps	24		
Grasping Forceps	39		
Ring-Handled Grasping Forceps	39		
Non-Ring-Handled Grasping Forceps	41		
Dissection Instrumentation	48		
Sharp Dissection Instrumentation	48		
Debulking	58		
Manual Debulking	58		
Probes and Dilators	61		
Measurement and Expansion	62		
Evacuation and Instillation Instrumentation	66		
Evacuation Instrumentation	66		
Injection and Irrigation Devices	68		
Retraction and Exposure	68		
Retractors	68		
Approximation and Closure Instrumentation	77		
Suturing Instrumentation	77		
Anesthesia Intubation Instruments	83		

Excisional Set	96	CHAPTER 10 BASIC BONE AND JOINT INSTRUMENTATION	244
Medium Foundation Set	109	Plates and Screws: Fracture Fixation	
Soft Tissue Dissection	109	Instrumentation	244
Long Foundation Set	122	Drills and Power Equipment	250
Laparotomy Set	122	Bone Instruments	254
Extra-Long “Add-On” Set	135	Small Bone Instruments	254
CHAPTER 6 PLASTIC SURGERY INSTRUMENTATION	136	Large Bone Instruments	254
Basic Plastic Surgery Instrumentation	136	CHAPTER 11 HEAD AND NECK PROCEDURE INSTRUMENTATION	285
Basic Plastic Surgery Procedures	164	Ear and Mastoid Instrumentation	285
Rhytidectomy-Browlift	164	Ear Instrumentation	286
Blepharoplasty	164	Mastoid Instrumentation	293
Surface and Subsurface Procedures	164	Nose and Throat Instrumentation	297
Debridement and Excisional Procedures	164	Intranasal and Pharyngeal Instrumentation	298
Liposuction	164	Anterior Neck Instrumentation	315
Breast Augmentation-Reduction Procedures	165	Thyroidectomy and Neck Dissection	
CHAPTER 7 GENERAL SURGERY INSTRUMENTATION	166	Instrumentation	315
General Surgery Major Laparotomy Tray	166	Tracheostomy-Tracheotomy	
Gastrointestinal Instrumentation for Open		Instrumentation	317
Procedures	180	CHAPTER 12 NEUROSURGERY INSTRUMENTATION	319
Cholecystectomy Add-Ons	180	Basic Neurosurgical Instrumentation	319
Liver and Stomach Add-Ons	182	Cranial Procedures	340
Lower Gastrointestinal Instrumentation for		Spinal Procedures	340
Open Procedures	184	CHAPTER 13 CARDIOTHORACIC AND VASCULAR INSTRUMENTATION	342
Bowel Resection Add-Ons	184	Basic Cardiothoracic and Vascular	
Rectal-Anal Instruments	189	Instrumentation	342
Hemorrhoidectomy and Rectal Excision	189	Basic Cardiothoracic and Vascular Procedures	375
CHAPTER 8 GYNECOLOGIC INSTRUMENTATION	195	CHAPTER 14 MICROSURGERY INSTRUMENTATION	376
Basic Gynecologic Instrumentation	196	Basic Microsurgery Instrumentation	376
Basic Gynecologic Procedures	227	CHAPTER 15 ENDOSCOPIC INSTRUMENTATION	395
Abdominal Hysterectomy	227	Essential Components of Endoscopic	
Vaginal Hysterectomy	227	Procedures	395
Vaginal-Perineal Procedures	227	Percutaneous Endoscopy Procedures	396
Dilation and Curettage	227	Nonpuncture Endoscopy	396
Cesarean Section	228	Access and Creation of the Working Space	396
CHAPTER 9 UROLOGIC INSTRUMENTATION	229	Illumination and Viewing within the Working	
Open Urology Instrumentation	229	Space	397
Nephrectomy, Cystectomy, and			
Prostatectomy Instrumentation	230		
Testicular Instrumentation	238		
Uroplasty Instrumentation	240		
Circumcision	242		

Manipulation within the Working Space	397
Irrigation and Evacuation within and from the Working Space	397
Closure within the Working Space	397
Specialty Instrumentation	397
Essential Endoscopic Instrumentation	398
Basic Endoscopic Procedures	409
Laparoscopy	409
Robotic-Assisted Percutaneous Endoscopy	409
Arthroscopy	412
Neuroendoscopy	412
Thoracoscopy	412
Mediastinoscopy	412
Upper Airway Endoscopy	412
Urologic Endoscopy	412

CHAPTER 16 DECONTAMINATION AND STERILIZATION	413
Decontamination	414
Instructions for Use (IFUs)	414
Cleaning	414
Inspection/Packaging	416
Processing	416
Disinfection	417
Sterilization	418
Sterile Storage and Packaging	419
Microbiological Concerns	421
Reprocessing Flexible Endoscopes	422
INDEX	427

PREFACE



This text, *Surgical Instrumentation, Second Edition*, is designed for perioperative personnel in all surgical disciplines. Surgeons, nurses, technologists, and technicians will find the design and collections in this book informative and user friendly. Books about surgical instrumentation have been in print for more than 100 years. However, none have offered comprehensive collections of instruments used with foundation sets for multiple specialties. They feature individual instruments without providing guidance for establishing or streamlining the set creation process.

THE DEVELOPMENT OF THIS TEXT

The four foundation sets described in this text are designed to be base units for use during procedures that meet the needed instrument weight, length, gauge, shape, and material necessary for a safe, efficient surgical procedure. The additional instrument groupings, such as those specific to a particular organ or region of the body, can be established as “add-on” sets to be used in combination with the appropriate foundation set.

Every perioperative nurse or surgical technologist who scrubs has encountered sets with instruments that have not been used for many years, yet the items continue to be packed into the tray for no apparent reason. This book may serve as a guide for establishing standardized instrument sets that will facilitate the count process and ease the burden of inventory control.

ORGANIZATION OF THE TEXT

This text is divided into 16 chapters. Images of the surgical instrumentation are displayed in table form with descriptions and sizes listed.

- *History of Surgical Instrumentation.* The first chapter describes the history of surgical

instrumentation and provides background information about the philosophy and contributions of different cultures to the discipline of surgery.

- *Anatomy and Physiology of Surgical Instrumentation.* The materials and characteristics of surgical instruments are explored, as well as the design from handle to tip.
- *Categories of Surgical Instrumentation.* Surgical instruments are designed for specific functions and are grouped into functional categories that define the purpose for each instrument. Specific groupings make it easier to learn the instruments.
- *Considerations for Instrument Set Assembly.* Trays and containers for packaging instruments are described in this chapter. Accountability is a team effort that begins with the construction and assembly of each set.
- *Soft Tissue Foundation Sets.* The foundation sets are designed to meet specific needs for a procedure at a basic level by grouping instruments by category and function.
- *Plastic Surgery Instrumentation.* Instruments specific to the type of plastic surgery procedure are described in combination with foundation sets.
- *General Surgery Instrumentation.* Functional instruments that are added to foundation sets for general surgery are described by organ system and body location.
- *Gynecologic Instrumentation.* Specialty instrumentation specific to the needs for surgery of the female reproductive tract is described.
- *Urologic Instrumentation.* Instrumentation specific to genitourinary procedures of the urethra and kidney is included in this chapter.

- *Basic Bone and Joint Instrumentation.* Many specialties utilize instrumentation to debulk, dissect, or repair bony tissue throughout the body. The bone instruments are used in combination with soft tissue foundation sets according to the location on the body.
- *Head and Neck Procedure Instrumentation.* Upper airway and otorhinolaryngology procedures require specialty instrumentation designed for narrow passages and the soft tissues of the anterior neck and throat.
- *Neurosurgery Instrumentation.* Procedures of the brain and spinal cord use a unique blend of soft tissue sets, compact tissue sets, and microsurgical sets. Instrumentation for procedures of the cranium and spine is described.
- *Cardiothoracic and Vascular Instrumentation.* Instrumentation used for surgical procedures of the lungs, heart, and vascular system is described.
- *Microsurgery Instrumentation.* Microsurgery is usually performed on soft tissues. These sets can be used in combination with foundation sets or as stand-alone sets.
- *Endoscopic Instrumentation.* The application of endoscopic techniques to multiple specialties is described. Percutaneous and natural orifice endoscopy is described in functional terms.
- *Decontamination and Sterilization.* A critical component in a complete understanding of surgical instrumentation is understanding decontamination and sterilization of the instruments. This new chapter includes information on cleaning (manual and mechanical), inspection, disinfection, sterilization, and packaging.

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CHAPTER 1

HISTORY OF SURGICAL INSTRUMENTATION



OBJECTIVES

After reading this chapter the learner should be able to:

1. Describe several historic findings that indicate ancient humans used surgical instruments.
2. Discuss the countries that contributed ideas to the surgical armamentarium.
3. List several materials that comprised early surgical instruments.

INTRODUCTION

Since the beginning of time, man has sought to appease the gods and remedy the failings of the human body with the medical and surgical arts. Each culture has historically approached medicine and surgery in a different way and has lent a societal touch to the evolution of surgical practice.

HISTORIC SURGICAL INSTRUMENTATION

Forms of early surgical practice encompassed tending injuries and wounds associated with animal encounters or battles. Some Neolithic tribes were known to have practiced amputation for serious injury, tumors, or infection. Relics of surgical instruments, such as sharpened flints and natural substances like shells, have been found wherever civilizations have been uncovered. Scientists have speculated dates ranging from 10,000 BC for early incisions to 2500 BC for suturing with horsehair or animal tendons.

Hindus developed the earliest known organized practice of surgery (shastrakarma), which is one of the eight branches of Ayurveda (Indian medicine). Shushruta (circa 800 BC), a medical practitioner from Benares, India, wrote the *Samhita*. In this text he described the need for cleanliness and precision in surgical treatment. His writings were captioned under seven topics: esya (exploration), ahrya (extraction), chedyā (excision), lekhyā (scarification), vedhya (puncturing), vsraya (evacuation), and sivyā (suturing). He based his methods of surgery on his studies of anatomy using dead bodies. Shushruta developed 121 separate surgical instruments of natural materials, such as bone, ivory, mussel shell, and stone. He also advocated the use of hypnosis and wine as anesthetics.

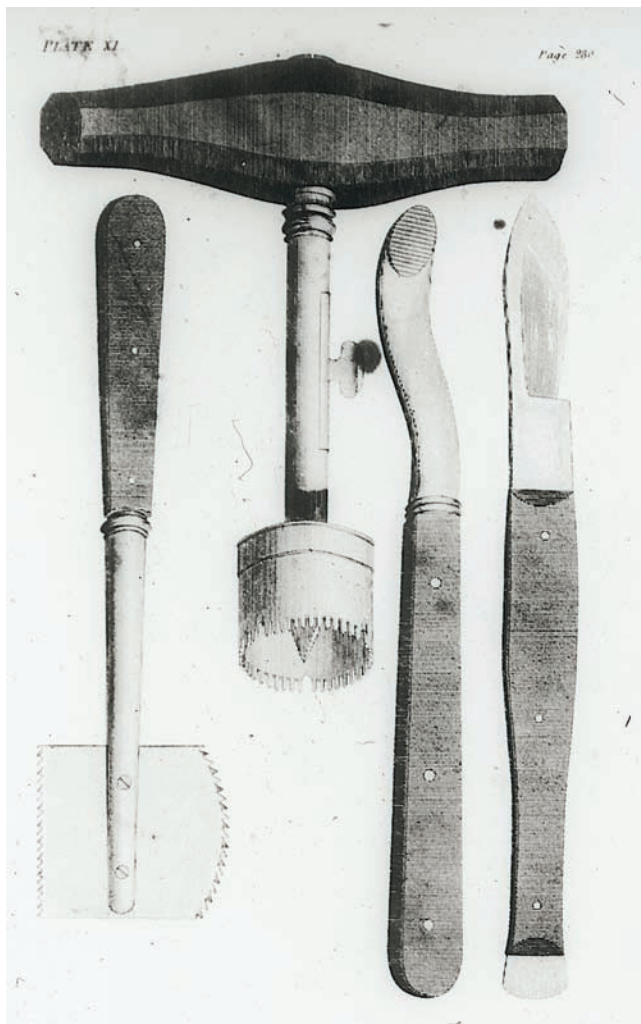
CHAPTER OUTLINE

Historic Surgical Instrumentation
Ritual and Magic

RITUAL AND MAGIC

Prehistoric man performed documented incisional procedures as early as 6000 BC. Scientists speculate that some procedures, such as opening holes into the skull (known as trepanation), were performed for ritualistic or magic reasons. Significant numbers of skulls have been found that indicate the patients lived for many years after the procedure, as new bone growth was identified around the cut edges of the bony holes. Figure 1-1 depicts trepanation instruments used for opening skull bone.

The ancient Egyptians did not feature cutting as a primary medical treatment. Egyptian temple and tomb art indicates that most of the anatomic study involved the embalming of bodies for burial. The religious sects were guardians of physical knowledge and held



Courtesy of the National Library of Medicine

Figure 1-1 Ancient trepanation instruments.

the internal anatomy sacred. Archeologists discovered papyri that described medical care during this period. In 1862, American Edwin Smith purchased a 22-page papyrus, dating from 1500 BC that contained many treatments performed during ancient times. It was later deciphered by James Henry Breasted. German Egyptologist George Ebers purchased a similar papyrus in 1872 that consisted of 110 pages that dated back to the First Dynasty in 3000 BC. A later papyrus was written as a guide for midwives and those who cared for female patients. These papyri contained medical and surgical references intermingled with magical spells for protection against supernatural forces.

Cataract surgery, known as couching in many ancient lands, was a common procedure between 1345 and 1200 BC. This surgery was performed by using a rodlike tool with a blunt end to tap the eye, causing the lens to shift away from the pupil. This allowed light to enter. Later methods of performing this procedure included inserting a needle into the eye to dislodge the natural lens (Figure 1-2).



Courtesy of the National Library of Medicine

Figure 1-2 Instruments used historically for cataract surgery.

Mesopotamian society (circa 3500 BC) exercised generalized laws and rules governing conduct. They had a concept of comparative worth concerning human life and believed in medical training before commencing practice. The physicians in Mesopotamia identified specific procedures, named each drug used in medical care, and kept records of medical and surgical activities by carving cuneiform figures into clay tablets. Over 20,000 such tablets have been discovered.

Ancient Babylonians (modern-day Iraq) were led by the great King Hammurabi (1795–1750 BC). He established the first known major metropolis and set forth the law that bears his name. The law was clear with regard to medical treatment. A surgeon who successfully treated his nobleman patient would be paid 10 shekels for his labor. If he treated a slave, he was paid 2 shekels, and for treatment of a freeman, he would be paid 5 shekels. If the nobleman or freeman patient died, the surgeon could lose a hand. If a slave died, the surgeon had to repay the cost of the slave to his master. The law was carved in black diorite stone that stood 8 feet tall and was designed like a monument for display in a public location in the city until it was taken by warring tribes as a trophy. It was discovered in Persia in 1901. The entire code of Hammurabi has been translated into English and is available online.

Greek civilization gave rise to more organized written texts on medicine and health. The Greeks encouraged a scholarly approach and established formal schools. Most of the surgery performed dealt with war wounds and orthopedic injury. The Greeks used palm bark and wood bound by moist clay and linen strips like splints to stabilize broken bones. Hippocrates (460–377 BC) used instruments of hardened iron, copper, bronze, and brass. His surgical armamentarium consisted of more than 200 types of surgical instruments. Although physicians were trained in medical and surgical treatments, the main focus of healthcare dealt with diet and exercise.

The early Romans had knowledge of steel. The ancient ruins of Pompeii (circa 310 BC to 79 AD) revealed an instrument manufacturer's place of business with preserved bundles of surgical tools made of several metals wrapped in protective fabric. Homes of physicians revealed beautifully carved boxes for instrument storage. Most of the surgical practice was borrowed from other cultures. Couching was performed as a

necessity to displace cataracts. Surgery was considered manual labor, and the ancient Roman physicians contributed very little to surgical knowledge. In fact, artists frequently had a greater knowledge of the human body than physicians because they studied corpses during postmortem dissection.

Arabian surgeons established a school for brain surgery in Islam in 800 AD. Other surgical procedures were also performed, such as couching. However, little was known of human anatomy because human dissection was banned by the Koran. During this era, Andalusia (Moorish Spain) was part of the Islamic Empire. A famous skilled Moorish surgeon of the time, El Zahrawi (940–1013 AD), wrote an encyclopedia of 30 volumes referred to as the *At-Tasrif* to record methods of medical and surgical treatment. He taught his students to treat each patient as an individual and to practice within ethical limits. His writings guided the development of most surgical textbooks in European universities between the 12th and 17th centuries AD. Many of the surgical instruments used during that period were designed by El Zahrawi himself, who personally drew the 200 illustrations for his texts. He is also credited with being the first to use ligatures for hemostasis in surgery. The history and images of El Zahrawi and other Muslim physicians are available online at <http://www.muslimheritage.com/surgery>.

The Chinese practiced acupuncture and acupressure for at least 2000 years of recorded history. The central belief of these practices is that there is a mind–body–spirit connection to health and wellness associated with the *ch'i*, or life force. The main focus of health and wellness was not based in surgical procedures, but in a pharmacopoeia of 1800 medicinal herbs, biologic materials, and chemicals.

The ancient Aztec civilization left little written history, but significant evidence of successful surgery has been unearthed in archeological explorations. They had a strong knowledge of human anatomy because their culture practiced human dissection on their enemies. They felt that they captured the essence of the life force if they cut the beating heart from the chest of their captives. Blood sacrifice was a daily event. The main feature of their surgical armamentarium was sharp dissection of bone and soft tissues.

SUMMARY

Throughout history, physicians have devised and modified available materials for use in surgical procedures. As scientists contributed new knowledge of metals and eventually synthetics, such as plastics, instrumentation became more functional, incorporating the principles of physics. The increasing

knowledge base concerning human anatomy and physiology led physicians to create new tools for exploration and treatment of body regions never surgically treated before. With each successive era, the sophistication of surgical instrumentation has improved significantly.

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CHAPTER 2

ANATOMY OF SURGICAL INSTRUMENTATION



OBJECTIVES

After reading this chapter the learner should be able to:

1. Discuss the evolution of ancient surgical instruments into designs in current use.
2. Describe the ergonomics of instrument design.
3. List the three essential design components of every surgical instrument.
4. List the common metals used in modern surgical instrumentation.

INTRODUCTION

Surgical instrumentation is one of the essential elements of a safe and efficient operating room. Even in the most skilled hands of a surgeon, the instruments must be in good condition and function as intended to prevent potential tissue damage. Surgical procedures require the use of a variety of instruments of different sizes, shapes, and chemical compositions in order to achieve a safe and optimal outcome for the patient. This chapter explores the broad range of unique design specifications of surgical instrumentation used to perform invasive procedures on all types of tissues and anatomic structures.

EVOLUTION OF MODERN SURGICAL INSTRUMENTATION

As discussed in Chapter 1, civilization has evolved and so, too, have surgical instruments and procedures. Conversely, human anatomy has not changed significantly over the centuries; however, the practice of surgical intervention has become increasingly complex in its goal to treat disease while minimizing tissue trauma, pain, and recovery time for patients.

CHAPTER OUTLINE

Evolution of Modern Surgical Instrumentation

Anatomy of a Surgical Instrument

Handle Styles

Joint Styles

Tip and Jaw Styles: Sharp Dissection

Tip and Jaw Styles: Clamping, Occluding, and Grasping

Tip Styles: Blunt Dissection

Categories of Surgical Instruments

How Surgical Instruments Are Named

Materials Used in the Manufacture of Surgical Instrumentation

Metallics

Steel

Copper

Titanium

Silver

Surface Finishes of Metallic Surgical Instruments

Inspection and Quality Control of Metallic Surgical Instruments

Scissors

Clamps, Needle Holders, and Graspers

Forceps

Retractors

Maintenance

Cleaning and Lubrication

Ultrasonic Cleansing

Despite these changes, much of our basic modern instrumentation has been modeled after long-standing styles with modifications for contemporary surgical procedures.

ANATOMY OF A SURGICAL INSTRUMENT

Basic design specifications are generally standardized according to the required function of the instrument. Modifications in size, shape, and design are made to accommodate the variety of human anatomic structures. Instruments can be classified by their use and function, which then determine the unique designs and shapes. A simple form of instrument anatomy is depicted by the small mosquito hemostat shown in Figure 2-1. It has all the standard design components, such as jaws, box locks, shanks, and handles. The essential standardized design components include the following:

- The handle or other form of hand grip held by the surgical practitioner

- The functional or connecting joint mechanism that allows the instrument sides to stay together in order to perform its task
- The tips and jaws are the working ends that come into contact with the patient's tissues and may be sharp, blunt, smooth, toothed, serrated, crushing, or noncrushing, also known as atraumatic.

Keeping these components in mind, the design possibilities are nearly limitless. Surgical instruments can be as simple as a flat sheet of metal or a single rod, or as complex as having up to 15 to 20 parts and pieces. Newer energized instrumentation can make contact with the patient's tissues through electrical current, radio frequencies, or collimated laser light waves.

Handle Styles

Handles are designed to optimize the operator's functional grip and dexterity. The working parts of an

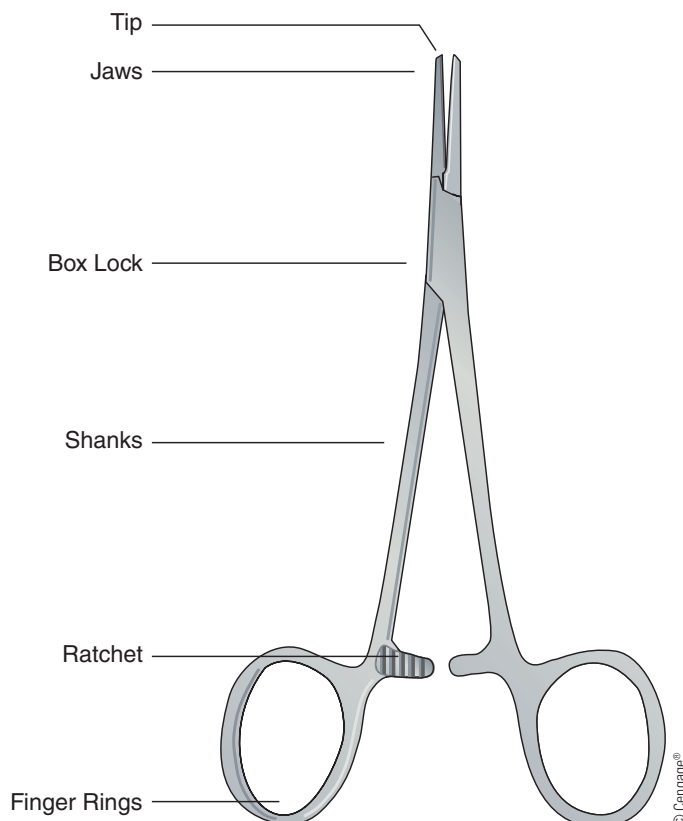


Figure 2-1 Basic anatomy of a surgical instrument (Halsted mosquito clamp).

instrument's jaws determine the style of the handle. Controlled and precise actions such as cutting, dissecting, and clamping require steady and secure manipulation as provided by ring handles and compression grips (Figure 2-2). Compression handles are pressure sensitive for precision closing power on heavy or firm tissues such as bone, cartilage, or fascia. Spring handles are preferred for microsurgery because activation of the jaws requires only minute motion to effect action

on delicate tissues (Figure 2-3). Ratchets are used to lock and keep constant pressure from both sides of the instrument to occlude flow, provide traction, or hold structures together (Figure 2-4). Pistol grip handles provide additional leverage for instruments with longer shafts used in narrow anatomic spaces or small incisions such as in open nasal or spinal procedures and in laparoscopic instruments, which must be inserted through percutaneous trocar cannulas (Figure 2-5).

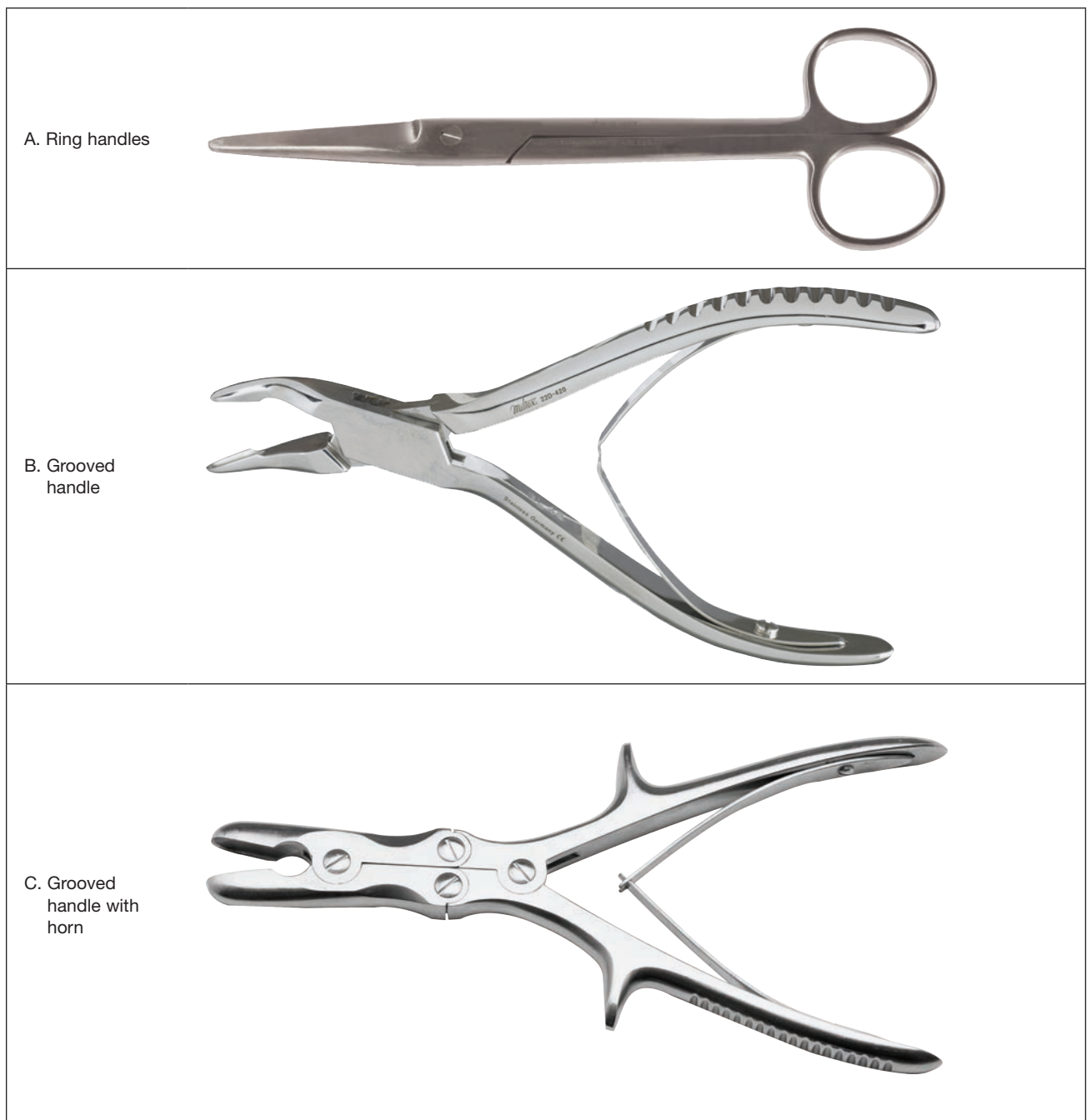
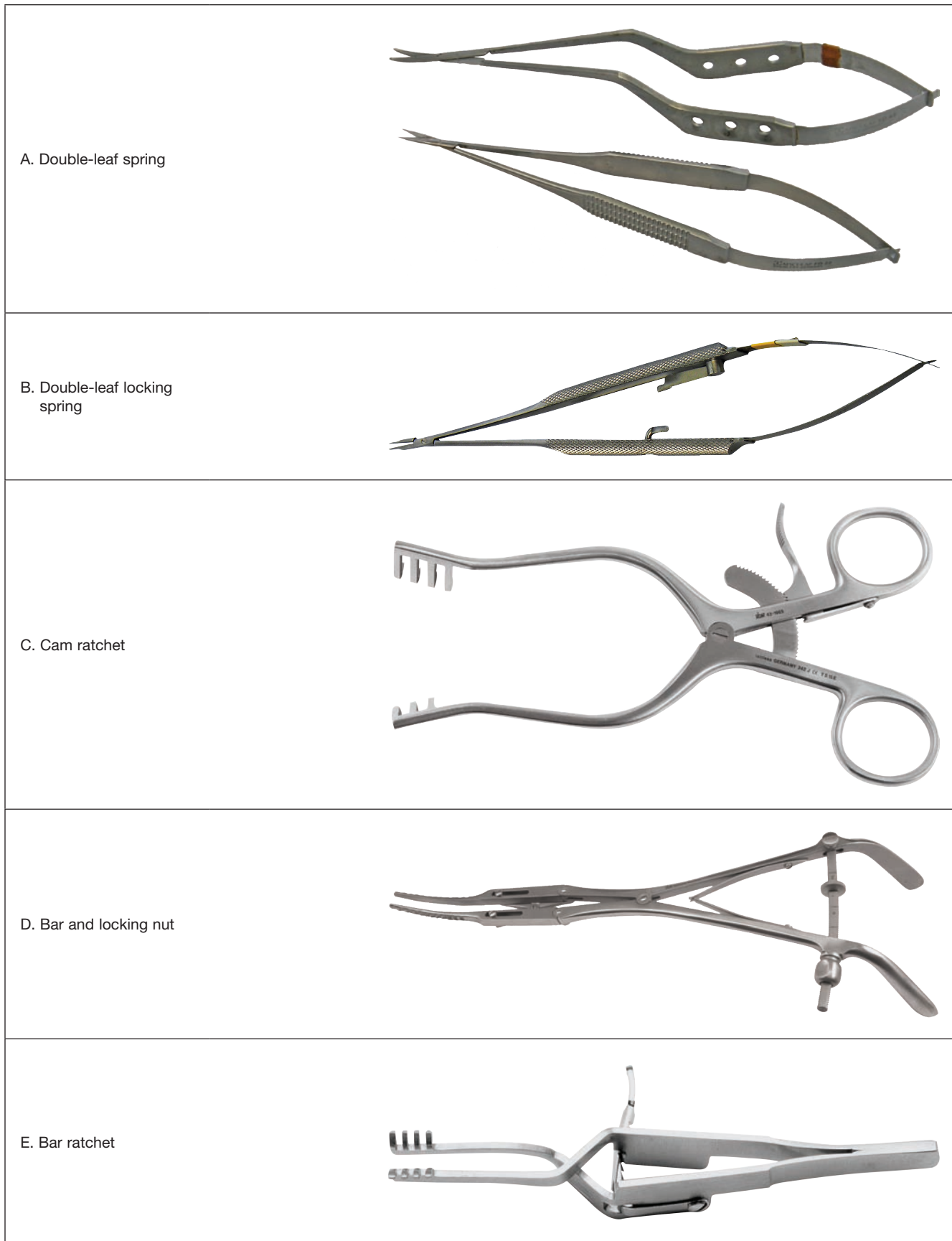
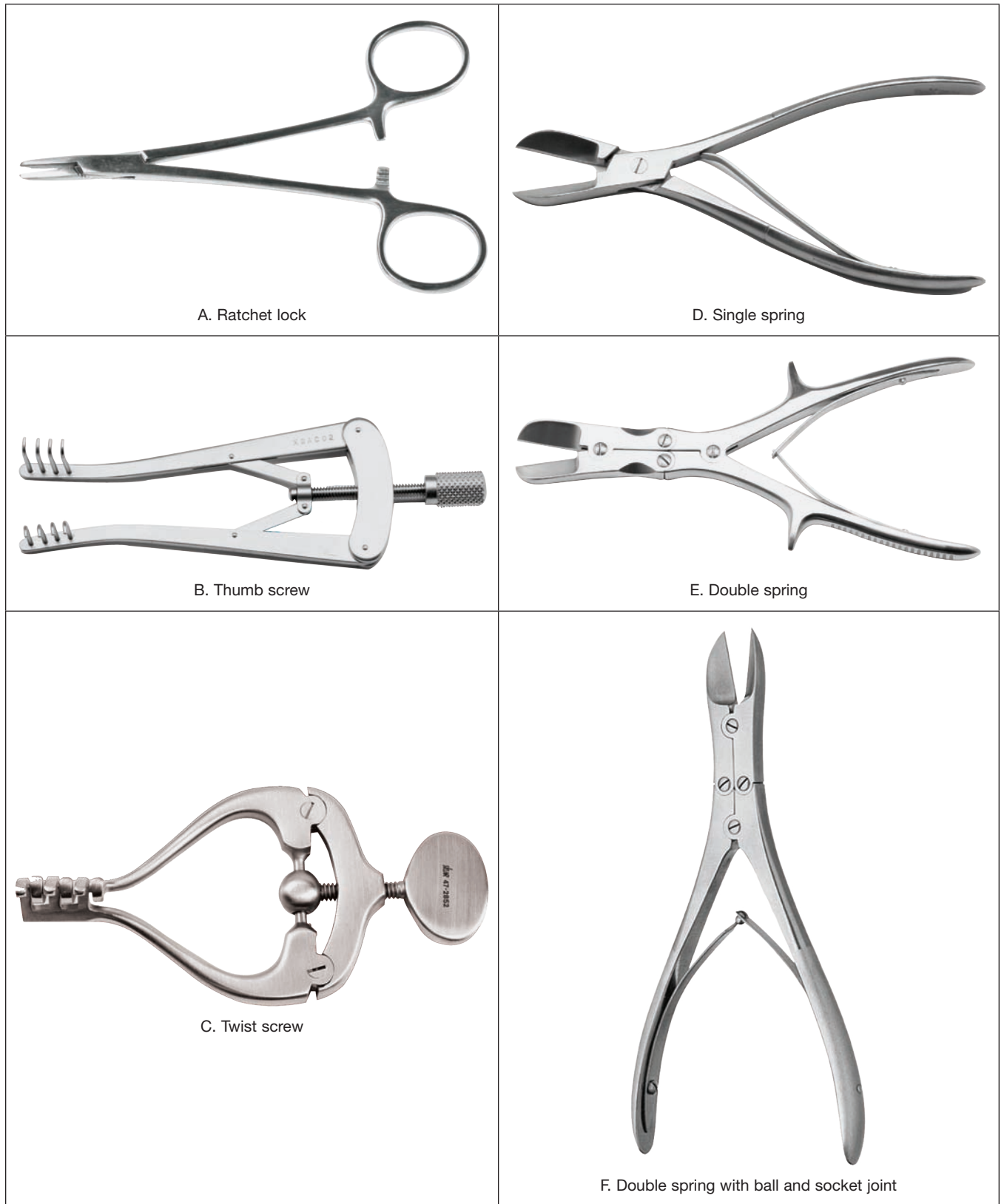


Figure 2-2 Ring handles and compression handle grips.



A-B: © 2019 Cengage®. Photo by Margaret Rodriguez. C-D: Courtesy of Sklar Instruments. E: © 2019 Cengage®.

Figure 2-3 Spring handles and locking handle grips.



A, C: Courtesy of Sklar Instruments. B, D-E: © 2019 Cengage®. F: Courtesy of CareFusion, a division of Becton, Dickinson and Co.

Figure 2-4 Locking and opposition handle system.