POWERED SURGICAL INSTRUMENTS: COMPONENTS OF SAFE CARE AND HANDLING

1959
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STUDY GUIDE

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# Powered Surgical Instruments: Components Of Safe Care And Handling

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PURPOSE/GOAL
This video and study guide will describe the various types of powered surgical instruments, their uses, basic components of their systems, and requirements for care and handling.

OBJECTIVES
Upon completion of this activity, the learner should be able to:

1. Identify three current applications of powered surgical instruments in the perioperative setting.
2. Describe the basic components of all powered surgical instruments.
3. Discuss the care and handling of powered surgical instruments.
4. List criteria for choosing a powered surgical instrument system.
INTRODUCTION
In today’s fast-paced, highly-technical health care environment, surgical techniques are constantly evolving. Because of ongoing advancements in surgical practice, surgeons are continually searching for high-quality instruments that will allow them to perform a variety of surgical interventions quickly and efficiently without compromising patient safety.

Manufacturers of surgical instruments have addressed these demands by developing powerful and versatile electrical, battery operated, and pneumatically driven surgical instruments and as a result, powered surgical instruments are used in nearly every surgical specialty.

The use of powered surgical instruments provides several advantages. Compared to hand-held instruments, powered surgical instruments

• allow surgeons to work more quickly and with greater efficiency, which in turn reduces surgical time for patients under anesthesia;
• cause less trauma to tissues and surrounding structures; and
• reduce surgeons’ fatigue.

These are all great advantages, but powered surgical instruments require additional safety and processing responsibilities for perioperative nurses and central sterilization and processing department personnel. Before any surgical procedure that involves the use of powered instruments, health care personnel are responsible for inspecting, assembling, and testing all powered devices.

Intraoperative nursing considerations include ensuring that the safety is engaged, cooling the blade with sterile saline during use, and troubleshooting when necessary. Postoperatively, powered surgical instruments must be properly cleaned, decontaminated, inspected, lubricated and assembled, packaged, sterilized, and stored in a controlled environment for the next use.

All personnel associated with procedures that involve the use of powered surgical instruments should understand all aspects of their proper use and care. This study guide is designed to provide that knowledge in general terms.

For information about the care and handling of specific powered surgical instruments, health care personnel should always refer to the device manufacturer’s validated written instructions.

HISTORICAL PERSPECTIVE
The earliest applications of powered surgical instruments were in the field of dentistry. In 1864, George F. Green, a mechanic employed by the S. S. White Company, introduced the first pneumatic engine designed for medical applications. Green’s engine was operated by a foot bellows and was used in dentistry, most likely to assist in drilling. With the invention of batteries and electric motors in the late 1800s, electrically powered dental drills became available, with the first one put into practice in 1871. M.H. Cryer developed a motor-driven osteotome in 1892. In the early 1900s, Dr. J. Vernon Luck created a powered circular saw for cutting bone. Soon after, Dr. Homer Hartmen Stryker created an oscillating saw that would cut bone but resisted cutting soft tissue. These early models had limited usefulness because they were powered by electrical motors that were attached to stands.

In 1957, motors driven by compressed air were developed by U.S. Navy research projects. In the 1960s, a small pneumatic motor powered by compressed nitrogen was introduced for use in surgical tools. Its use assuaged concerns about spark formation by electrical tools in the presence of flammable anesthetics. The pneumatic motor in those devices was contained in the handpiece itself. It is considered the forerunner of the pneumatic motor used in today’s air-powered surgical instruments.

CURRENT APPLICATIONS
Today, powered surgical instruments are used successfully and routinely in most surgical specialties, with the majority in orthopedics; ear, nose, and throat surgery; thoracic surgery; neurosurgery; oral surgery; and plastic and reconstructive surgery. Selection of a specific powered instrument or attachment is determined by the surgical specialty, the needs of the planned procedure, and the surgeon’s preference. The
applications of powered surgical instruments can be as varied as the surgeons who use them.

Orthopedics
Powered surgical instruments are used most often in the field of orthopedic surgery, which frequently requires sawing or drilling through hard bone. Orthopedic surgeons use powered instruments to cut, drill, or shape bone, and to drive screws, pins, or K-wires into bone.

One value of using powered instruments is that they make working with bone easier and faster than working by hand. Another advantage is that blood loss from bone is reduced by the tiny particles these high-speed instruments pack into the cut surfaces.

Saw attachments used in orthopedics have several actions.

- Reciprocating saws move forward and backward in the vertical plane.
- Oscillating saws move in a windshield-wiper motion at a 90-degree angle to the handpiece.
- Sagittal saws move from side to side in line with the handpiece.

Rotary attachments for powered surgical instruments also have orthopedic applications:

- Acetabular reamers prepare the acetabular surface for cup insertion in hip arthroplasty.
- Femoral reamers prepare the femoral canal for insertion of stemmed femoral prostheses.
- Drills prepare screw holes and insert guidewires into bone to allow further drilling, reaming, and screw tapping for the repair and reconstruction of fractures.
- Automatic screwdrivers place screws in bone.
- K-wire drivers place pins in bone.

Specialty attachments and handpieces also provide other unique actions that are useful in orthopedic surgery:

- Rasp shape bone.
- Osteotomes cut bone.
- Powered rongeurs assist with bone removal.
- Other special attachments aid in cement removal.
- Powered shavers cut the meniscus in the knee.

Thoracic Surgery
The use of a sternal saw in thoracic surgery was first reported in 1962. The first model was a modification of a Sears® brand handyman’s saber saw. Today, open-heart surgeons routinely use powered sternal saws to split the sternum. Modern sternal saws reciprocate in a vertical plane.

Plastic and Reconstructive Surgery
In plastic and reconstructive surgery, surgeons use dermatomes for removing split-thickness skin grafts from donor sites. They obtain a graft with a knife blade that moves back and forth, like the blade of an electric hair clipper. A long sterile cable serves as the drive shaft and runs between the dermatome and its power source. The surgeon can activate the motor using a foot pedal or hand control.

Neurosurgery
In neurosurgery, the use of powered surgical instrumentation has been popular since Dr. Robert M. Hall introduced the Hall® Neurairtome rotary cutting device in 1965. Today, almost any neurosurgical procedure, such as laminectomies, craniotomies, or skull-based surgery, is performed using a special high-speed drill system. The use of high-power drill systems in spinal surgeries allows laminectomies to be performed more safely and more quickly, decreasing the length of hospital stays and the rates of both short- and long-term complications.

Neurosurgeons use powered cranial perforators to create burr holes in the skull. When used properly, the perforator stops automatically before the dura is penetrated. A saw blade with a dural guard makes cuts in the skull between the burr holes. A wire pass attachment permits the drilling of small holes to reattach bone flaps. Surgeons also use power drills to widen the graft area in anterior fusions and to unroof the auditory canal in eighth cranial nerve surgery. For use in less accessible areas, such as the sphenoidal sinus, pituitary fossa, and vertebral bodies, 20-degree and 90-degree angle attachments are available. A range of burs and guards that can be used with straight or angled attachments is available for use in neurosurgery.

Oral Surgery
Oral surgeons employ tiny power-driven saws made
specifically for use in hard-to-reach places. Applications of powered surgical instruments in oral surgery include bone-cutting for the removal of impacted teeth, osseous contouring in periodontology, and apical surgery for endodontics.

**SYSTEM COMPONENTS**

Powered surgical instrument systems are complex and involve a variety of gears, rotating shafts, seals, and other diverse components. Most, however, will have the following basic parts:

- A power source, which may be compressed gas, alternating current (AC), or direct current (DC).
- A hose or cord that connects the power source to the handpiece (AC and pneumatically powered instruments only).
- The handpiece itself.
- Hand- or foot-operated controls.
- Accessory attachments.

**Power Source**

Powered surgical instruments can be classified by the source of their power:

- Compressed gas (air or nitrogen) powers pneumatic instruments.
- AC (wall current) powers electrical instruments.
- DC powers battery-operated instruments.

**Pneumatic Instruments**

Medical-grade compressed air or compressed dry nitrogen (99.97% pure) power pneumatic instruments. This gas may be contained in a metal cylinder or may be piped into the surgical suite through a wall panel or overhead line.

Most modern facilities use pipe-in technology, where gas systems are centrally located and are constructed as an integral part of the physical facility. Individual outlets and regulators are available in each procedure room for use with surgical instruments. These outlets may be part of the anesthesia gas panel, located in booms, or be in a separate location that is more readily accessible to the operative field (wall panels). Wall panels incorporate pressure gauges that measure the flow of the gas. In some healthcare facilities, large cylinders of compressed gas may be used to provide pneumatic power. A regulator controls the flow of gas at a specified number of pounds per square inch (psi). In order for the pneumatic hose to connect with the power supply, compatible fittings must be available.

Pneumatic instruments do not require sizeable motors or additional attachments; therefore, they are small, lightweight, self contained, free of vibration, and easy to handle for pinpoint accuracy at high speeds. Because they operate at higher speeds than electrically powered instruments, they cause less heating of the target tissue.

Disadvantages of pneumatic instruments include the fact that they can be relatively expensive, and the hose that runs from the gas supply to the handpiece may restrict the surgeon’s maneuverability. In addition, the surgical team must take care to ensure that the connections to the instrument and the gas source are secure to decrease the risk of injury if they become disconnected during use.

**Alternating Current (Wall Current)**

Some powered surgical instruments may be plugged into wall current, also known as AC.

Electrically powered instruments, such as saws, drills, dermatomes, and nerve stimulators, were at one time considered potential explosion hazards in the OR because of the use of flammable anesthetics.

With the introduction of less flammable anesthetic gases, this risk is reduced; however, all electrical motors should be designed to be explosion-proof and must have spark-proof connectors.

Flexible drive shaft electric drills are relatively inexpensive but can be tiring to use because of the weight of the drive shaft.
Their top speed is limited to moderate levels, but their torque, or rotating force, is good. Micromotor electric drills, often used in dental surgery, have small, low-voltage motors in the drill handpiece. They are lightweight and easy to manipulate, with only a thin flexible tube leading to the power supply. They have high top speeds and good torque over the whole speed range.

**Direct Current (Battery Power)**

Battery-powered surgical instruments are becoming the standard in health care today. Most battery-powered instruments are cordless, with a rechargeable battery pack mounted into the handpiece. The battery pack can be charged when the instrument is not in use and sterilized immediately before the instrument is used. Battery powered instruments eliminate the need for compressed gas or wall power, and there is no need for a hose or cord connecting the sterile field to the power source. Manufacturer’s written directions should be followed for care and handling of the battery.

**Handpiece and Controls**

Fingertip controls on the handpieces of some battery-powered or pneumatic instruments permit the surgeon to vary the speed and torque delivered by powered saws, drills, and reamers. Some powered surgical instruments can be activated by foot pedal controls.

**Accessories**

Depending on the function required, a drill bit, bur, blade, reamer, acetabular or femoral reamer, or other attachment of appropriate size may be inserted into the handpiece. Many of these accessories are supplied sterile and considered single use items.

**PREOPERATIVE CARE AND HANDLING**

Powered surgical instruments represent a major financial investment for health care facilities, and they are expensive to repair or replace. Following manufacturers’ written instructions for proper care and handling helps to protect this investment. Proper care of powered surgical instruments can only be achieved through collaboration with surgical services and central sterile processing personnel, surgeons, and manufacturers.

The following are general recommendations for use and care of powered surgical instruments. However, because manufacturers continue to improve and develop their powered instruments, each powered surgical instrument will have its own specific requirements for assembly, intraoperative handling, troubleshooting, cleaning, decontamination, lubrication, packaging, and sterilization. Be sure to follow specific written instructions for use and care of such equipment provided by the manufacturer at the time of purchase. These written instructions should be readily accessible for reference in the health care facility.

Facility staff members should receive initial and ongoing education on powered surgical instruments. This could be provided by the vendor during an inservice presentation or it could be provided by a facility resource, such as an OR educator or clinical specialist who has confirmed care and handling guidelines with the manufacturer.

**Set Up and Assembly**

Before the surgical procedure begins, all powered instruments must be assembled and tested with the appropriate attachments in place. Additional precautions may be required, depending on the power source used.

**Gas Cylinders**

If gas cylinders are used, the health care facility should have written guidelines for handling, storing, and cleaning gas cylinders. Cylinders should be secured by a chain to a supporting wall, a portable stand or dolly. When moving gas cylinders, always use a cylinder carrier and lock the cylinder securely into the carrier before transportation. Never allow a gas cylinder to fall over—if a cylinder falls and breaks, it can act as a projectile, potentially causing serious damage or even death.

If using a gas cylinder, take the following steps to attach a regulator before bringing the cylinder into the procedure room:

- Identify the gas cylinder. The medical gas in the cylinder must be clearly identified by the color of the
cylinder, a label, and a pin index safety system.

- Wipe off the cylinder and carrier.
- Open the tank valve very slowly.
- Allow only enough gas to escape to remove any dust that may have accumulated.
- Attach the regulator by hand and secure it with a wrench.
- Ensure that the regulator is turned completely off.

**Electrical Equipment**

Care should be taken when using all electrical equipment. Cords should be laid flat on the floor to eliminate the potential for tripping or accidental unplugging of electrical equipment. Keep cords away from pooled fluids. Cords with undetected frays or damage that are lying in water or other fluid present electrical hazards to personnel. Only grounded outlets should be used for electrical powered equipment.

**Inspection**

AORN’s recommended practices for the cleaning and care of surgical instruments and powered equipment specify that “Powered surgical instruments and all attachments should be decontaminated, lubricated, assembled, sterilized and tested before use according to the manufacturers’ written instructions.” Whenever a new powered surgical instrument is purchased and delivered to the facility, it should be inspected carefully. The packaging should be checked for damage that may have occurred during shipment. All contents should be confirmed for completeness and number of parts. A device manufacturer’s validated written instructions should be included. Upon arrival and before sterilization, instruments should be decontaminated to remove any contaminants, such as loose debris and lubricants that may be present for protection during shipment.

Before presentation of a powered surgical instrument to the sterile field, the sterile packaging should be inspected for any evidence of being dropped or damaged, such as tears or holes in the packaging material. If potential packaging damage is suspected, the instrument should be checked by the biomedical engineering department (or the manufacturer) before being used. If the package is intact, carefully open the wrapper or container and deliver the contents to the sterile field using aseptic technique.

Before using a pneumatic instrument, the manufacturer’s written instructions should be consulted to determine the correct gas pressure setting required to operate the equipment safely. This pressure is measured when the equipment is operating. Pneumatic instruments that will be powered by a gas cylinder will also require that the RN circulator check the amount of pressure remaining in the cylinder that will be used. Cylinders should be replaced when the pressure falls to a level of 500 psi or less. Using cylinders with a remaining pressure of less than 500 psi or less is not recommended.

If an AC-powered device will be used, the RN circulator should check electrical cords for integrity and check the prongs of electrical plugs for alignment, because shock may result if the cord is frayed or the prongs are not properly aligned. Electrical outlets should be accessible and in proper working order, because damaged outlets and switch plates may result in excessive current leakage and cause patient or personnel injury. If an electrical cord is passed from the operative field to an electrical outlet, make sure it is long enough to reach the floor and that it lies flat on the floor. This prevents accidental tripping by OR personnel and decreases the possibility of accidental disconnection of the cord from the power source. Cords may be secured to the floor if desired.

Before use of any powered surgical equipment on the sterile field, scrub personnel should inspect it thoroughly. Steps to ensure safe use include:

- The air hose should be inspected for damage or wear before and after decontamination and before use. If the hose shows evidence of wear or damage, do not use it. A damaged hose could cause injury to the patient or personnel.
- If applicable, inspect batteries and battery compartments for corrosion and other possible damage or defects.
- To avoid accidental activation, make sure the trigger on the handpiece is in the safety position and that on-off switches are in the off position.
- Inspect accessories to ensure the integrity and sharpness of cutting edges. Blunt drill bits, for example, may cause unnecessary thermal damage. In addition, the increased force required for penetration of a dull drill bit may result in sudden bursting through the bony cortex, with inadvertent damage to soft
tissues. The increased force required may also result in broken drill bits and possible injury from the sharp ends.

- Inspect the straightness of all accessories. Bent saw blades could decrease the life of the instrument due to the increased force that must be exerted by the motor for the blade to function. A bent bur may snap during use, presenting a major safety hazard to the patient and personnel. To test a bur shaft for straightness, roll it on a flat surface—a bent bur will not roll freely.

Assembly
Before assembling a powered surgical instrument, it is important to read and understand the assembly and use instructions provided by the manufacturer. There are a variety of connectors for use with powered surgical instruments, and connecting systems cannot be used interchangeably. When using pneumatic powered surgical instruments the diffuser end of the hose should attach firmly to the regulator. An improper diffuser/regulator connection could result in faulty operation of the instrument, gas leakage, and undue stress on the instrument.

Setting Pneumatic Pressure
When using pneumatic instruments, the correct pressure (usually measured in psi), as determined by the manufacturer of the instrument, should be used. This pressure should be measured with the instrument activated to ensure correct operating pressure. Unless the pressure is set while pneumatic equipment is operating, the resulting operating pressures may be too high or too low. A gas pressure that is too high can damage the instrument and place great stress on the hose. A gas pressure that is less than what is recommended by the manufacturer can place unnecessary or unwanted stress on the instrument, because it must work harder to meet the demands placed on it. This stress will cause overheating and premature wear and tear on the motor and other moving parts. The pressure required to drive the motor in a pneumatic instrument may vary with the task expected for the equipment. For microdrills, such as those used in microsurgery on the ear, 80 to 90 psi is an appropriate pressure. For sculpting or cutting large, hard bones, a larger drill system that operates at a pressure of 110 psi with up to 20,000 revolutions per minute should be used.

Testing
All powered surgical instruments should be tested with attachments in place prior to the beginning of the procedure to ensure that all parts are functional and running smoothly. Test each individual component to verify its function. When testing the operation of the handpiece, be sure to test the safety, reverse, forward, or other controls according to the manufacturer’s instructions.

When testing pneumatic pressure, open the cylinder valve slowly with the face of the gauge on the regulator pointed away from any person. Repair or replace any improperly functioning valves. Do not automatically increase the gas pressure if the operation of a pneumatic instrument is sluggish or erratic. Instead, follow the sequence of steps listed in the “Intraoperative Troubleshooting” section.

INTRAOPERATIVE CARE AND HANDLING
Once the surgical procedure begins, the scrub person is responsible for making sure the proper accessories are supplied according to the surgeon’s preference, and that the accessories are properly attached to the handpiece and continue to function properly.
Personnel Protection
During operation of high-speed powered surgical instruments, a fine mist of blood and bone cells may be dispersed. For this reason, the American Academy of Orthopaedic Surgeons recommends that personnel wear protective eyewear when powered instruments are in use. Similarly, the Occupational Safety and Health Administration bloodborne pathogens standard requires that employers supply masks in combination with eye protection devices, such as goggles or glasses with solid side shields or chin-length face shields, whenever splashes, spray, spatter, or droplets of blood or other potentially infectious materials may be generated, and eye, nose, or mouth contamination can be reasonably anticipated.

It is important for perioperative team members to be aware of sharps safety procedures when working with powered surgical equipment. Unless the movement of powered surgical instruments is carefully controlled, nontarget tissue, including the surgeon’s or assistant’s fingers, can be caught in a rapidly spinning drill or oscillating saw. The instrument may cut more than desired. Whenever a powered instrument is being used, particularly one with rotating movement, all team members must be very careful to keep their hands away from the blade.

Some tips for safely passing powered surgical instruments include
- keeping the safety on,
- using a safe zone, and
- verbally indicating when you are passing the equipment to avoid injury to yourself or others.

When you are finished using the instrument, remove all disposable sharp items and dispose of them into the appropriate sharps containers.

After the procedure is over, when breaking down the sterile field, segregate the sharp instruments and arrange them to decrease the potential for injury to the staff members who will be reprocessing the equipment.

When attaching or detaching the power source to the equipment, follow the device manufacturer’s instructions to secure the connections appropriately and power the equipment as severe injuries can and have occurred when the powered surgical equipment and hoses are connected and/or disconnected.

Maintain Trigger or Control in Safety Position
After the powered surgical instrument has been connected to the power source and tested for proper functioning, the trigger or finger control should be placed in the safety position, and kept in that position whenever the instrument is not in use. Accidental activation can cause serious injury. The trigger or control should also be maintained in the safety position during placement and replacement of attachments intraoperatively. Be sure to seat attachments securely in the handpiece.

Use Saline to Cool Attachments
As early as 500 BC, Hippocrates suggested that cooling should be applied to the trepanning tool (trephine) when disks of bone were removed from the skull. Today, there is widespread agreement that powered cutting instruments should be cooled to minimize temperature rise. Another means of minimizing temperature rise is to use sharp drills, saws, and blades. Using overheated components can heat bone cells above 50°C, which causes irreversible change to the physical properties of bone due to changes in the collagen matrix. The extent of the necrosis that results from using overheated components depends on the temperature reached and its duration. When powered instruments are used on bone, a bulb syringe should be used to dispense saline solution onto the cutting edge. This will disperse the heat generated by the blade and wash away particles of bone and tissue. The saline also reduces friction and prevents the tissue from drying out.

Use Plastic Suction Tips
High-speed burs used in conjunction with metal suction tips can disperse very fine metallic particles into the soft tissue adjacent to the operative area. Although the particles themselves have no immediate clinical effects, they may cause a distortion effect if the patient requires magnetic resonance imaging (MRI) studies of the area in the future. For this reason, plastic suction tips should always be used with high-speed burs or drills.

Place Powered Equipment On A Separate Table When Not in Use
Never rest powered surgical instruments on the patient. If the instrument is too large or cumbersome to be placed on the back table when not in use, prepare a separate sterile table or Mayo stand to hold it.

This practice prevents serious injury to the patient from the
weight of the instrument or from accidental activation. It also prevents the instrument from falling off the sterile field and avoids accidental contamination from saws and blades tearing through draping materials. When the equipment is set up and not in use, the scrub person should place the equipment in a secure area on the sterile field to avoid accidental sharps injury to the scrubbed team members.

**Intraoperative Troubleshooting**
If a malfunction occurs, check all components sequentially in order to locate and correct the problem. Components should be checked in the following order:

1. Power source  
2. Hose, cord, or battery  
3. Throttle  
4. Handpiece  
5. Accessory attachments  
6. Controls and/or safety switch

Standardized troubleshooting can save costly repair fees, decrease surgical delays, eliminate unnecessary downtime for repairs, and reduce stress for all members of the surgical team.

If a pneumatic hose connection appears to be leaking, it may be the result of a damaged or missing O-ring. Often the O-ring can be replaced without sending the powered instrument back to the manufacturer.

**POSTOPERATIVE CARE AND HANDLING**
All components of powered surgical instruments require special postoperative care and handling, including cleaning, decontamination, inspection, lubrication, assembly, packaging, sterilization, preventive maintenance, and repairs. With the assistance of central services personnel and specialty nursing team leaders, each manufacturer’s instructions for reprocessing powered surgical instruments should be available for review at all times. It is important to note that each powered instrument and its component parts have different processing requirements.

Sterilization cycle parameters that are recommended by the device manufacturer should be reconciled with the manufacturer’s written instructions for the type of sterilizer and the specific sterilization cycle and load configuration that will be used. If the sterilizer and the device manufacturer’s written recommendations cannot be reconciled, the device manufacturer’s instructions should be used. Many pneumatically powered instruments and rigid container systems may require longer exposure times or drying times than other types of equipment.

The number of microorganisms present on a powered surgical instrument varies, depending on the instrument’s size, design, complexity, and condition; the degree of contamination during use; and the effectiveness of subsequent decontamination and cleaning procedures. Manufacturers validate sterilization methods for their instruments with a specific biological challenge in the most difficult area to sterilize and recommend sterilization cycle parameters accordingly.

**Cleaning and Decontamination**
Throughout the surgical procedure, powered surgical instruments should be kept free of blood and other organic debris by continually wiping them with radiopaque 4x4s, lap sponges, or a towel dampened with sterile water. Do not use saline, which can cause pitting and corrosion of metal. Simple wiping decreases the bioburden on the instrument and helps keep debris away from moving parts. If organic debris is left on powered equipment, it can hinder the sterilization process and may interfere with proper functioning.

After the surgical procedure, AORN recommends that powered equipment be cleaned and decontaminated immediately, in accordance with the manufacturer’s written instructions. Manufacturers have specific recommendations for the correct method of cleaning and decontaminating powered instruments. These instruments contain complex
lumens, movable parts, and intricate internal components. Most are not immersible and therefore present challenges in the cleaning process.

Cleaning instructions vary with each manufacturer, but the following are general guidelines for cleaning powered surgical instruments:

Blades and drill bits should be removed from powered instruments in the OR by the scrub person after the procedure has ended. Blades, bits, and other disposable sharp items should be disposed of in appropriate sharps containers and sharp reusable items should be segregated into a container that is easily recognizable to indicate sharp objects.

1. If specified by the manufacturer, disassemble attachments for thorough cleaning.

2. Powered surgical instruments should not be immersed or placed under running water, in ultrasonic cleaners, washer disinfectors, or washer sterilizers unless this is indicated in the manufacturer’s written directions.

3. To prevent entry of moisture into the connection, leave the air hose attached to the handpiece of pneumatic instruments during cleaning. Permanent damage can result from water or other fluid entering the internal mechanism of the instrument.

4. Wipe the surfaces of air hoses, electrical cords, and hand pieces with a mild detergent/disinfectant solution recommended by the manufacturer, taking care not to allow any solution to enter the internal mechanism. Use a cloth or soft-bristled brush. Hold the hose coiled with both ends hanging down to prevent water from entering the open ends. If the equipment has an electrical cord, inspect it for cracks in the insulation and wipe it with a cloth soaked with mild detergent solution. Clean other components with lukewarm water, a mild detergent, and a soft brush, as recommended by the manufacturer.

5. All traces of the detergent or disinfectant should be wiped off with a damp cloth.

6. Rinse carefully with distilled or de-ionized water to remove all traces of detergent solution, debris, or tissue irritants.

7. While cleaning, hold the handpiece with the nose pointed down to ensure that moisture does not run into the instrument.

8. Pay special attention to cannulated areas, triggers, and intricate crevices to ensure removal of all blood and tissue debris.

9. To prevent spotting, dry the outside of the handpiece with a clean, lint-free towel.

10. Dry small or delicate areas with cotton-tipped applicators.

11. Dry lumens by attaching a syringe and forcing air through the lumen. Pipe cleaners may also be used.

12. If the instrument is to be sterilized with ethylene oxide, the manufacturer may recommend drying of channels using compressed air. Complete drying is necessary to eliminate the formation of ethylene glycol (also known as antifreeze), a harmful residue that results when ethylene oxide combines with water.

**Lubrication**

Due to different manufacturing designs, powered instruments may or may not require the use of solvents and lubricants to increase instrument life. Some powered surgical instruments do not require any lubrication, but when lubrication is recommended by the manufacturer, it is essential for proper functioning and sterilization.

If lubrication is recommended, lubricate powered equipment and attachments according to manufacturers’ written instructions. The component or components to be lubricated may vary. Correlate the method and type of lubrication with the method of sterilization. Each manufacturer can specify the appropriate product for their equipment. Some manufacturers supply the lubricant, usually silicone oil. Some powered surgical instruments must be run after lubrication to ensure dispersion of the lubricant.

**Disassembly**

After the instrument has been thoroughly cleaned and decontaminated, it is ready to be packaged and sterilized according to the manufacturer’s recommendations. Before sterilization, disassemble all powered instruments to ensure that the sterilizing agent contacts all component parts.

**Packaging**

AORN’s recommended practices state that “Powered surgical instruments should be packaged and sterilized according to manufacturer’s instructions before use.” When packaging powered surgical instruments for sterilization, use appropriate containers and packaging materials. Some manufacturers
include perforated cases with compartments for their powered surgical instruments. These can be wrapped in woven or nonwoven material. Others recommend standard cases or pans, as well as wrapping materials. The goal should be to ensure that the packaging selected promotes successful sterilization.

When packaging powered surgical instruments for sterilization, include all components in the set. To ensure that all parts are included in the tray, a concise, easy to use, pictorial reference showing the components may be helpful. Protect delicate parts by inserting them into the appropriate compartments in their dedicated cases or by packaging them separately. If parts are packaged separately, keep them with the powered instrument to avoid damage or loss. Individual parts usually are not interchangeable between different powered instruments. Cords and hoses should be coiled loosely for placement in the sterilization container to avoid breakage or undue stress or tension on the cord itself and/or its internal structures.

Arrange all components so that all surfaces are directly exposed to the sterilizing agent for the prescribed time and temperature. When using steam sterilization, materials and containers should allow for adequate air removal and steam penetration. When ethylene oxide is used, the container must allow for adequate penetration and release of gas sterilant and moisture.

**Sterilization**

Because their designs vary, each type of powered instrument should be cared for and sterilized according to the manufacturer’s instructions or irreversible damage to the powered instrument may result. Each manufacturer should be able to provide validated sterilization parameters for each powered instrument that they provide. It is critical that the sterilization process chosen sterilizes even the internal mechanisms of powered surgical instruments.

**Steam Sterilization – Saturated Steam Under Pressure**

Saturated steam under pressure is most often used to sterilize powered surgical instruments, unless contraindicated by the manufacturer. The device manufacturer may validate a specific method of air removal and recommend a certain type of steam sterilization cycle or may specify the achievement of certain cycle parameters in their written instructions for use.

Steam exposure time is very important, as are the temperature, type of sterilizer, and type of powered instrument. Follow the sterilization parameters (time, temperature, and pressure) recommended by the manufacturer of each specific powered surgical instrument. Optimal sterilization parameters will vary according to the mass, configuration, and lubrication of the particular instrument, as well as with the type of packaging and the sterilizer used. Because of variables in the construction and uses of powered surgical instruments, it is not unusual for manufacturers to recommend a wide range of sterilization times and temperatures.

Immediate use steam sterilization is not recommended for powered surgical instruments because it does not reliably sterilize the internal mechanisms of powered surgical instruments. The air in the lumens of cords and hoses is heavier than the incoming steam and may not be totally displaced by a gravity steam flow. If there is a lag in the temperature within the lumen, sufficient temperature may not be achieved. Furthermore, the internal workings of powered surgical instruments are complex, inhibiting steam penetration and therefore limiting microbial kill within the inner workings of the instrument. Unless all organisms are inactivated, pathogenic microorganisms may be propelled into the wound or onto the sterile field as the gas exhausts from either the handpiece or the hose. These instruments should be packaged and subjected to a full sterilization cycle by central services personnel.

**Ethylene Oxide Sterilization**

Ethylene oxide is an alkylating agent that, under the right conditions (time, temperature, concentration, and humidity) can result in microbial death. It may not sterilize the internal mechanisms of powered equipment, as gas does not diffuse readily through lubricants. Use ethylene oxide to sterilize powered surgical instruments only if specified by the manufacturer. Do not use lubricants when using ethylene oxide sterilization, as they impede diffusion of the gas through the internal mechanisms. Be sure to follow the aeration times recommended by the manufacturer.
Sterile Storage
After sterilization, powered surgical instruments should be stored in a manner to ensure sterility under environmentally controlled conditions.

Nonsterile Storage
Store all nonsterile power sources in an unsterile storage area immediately adjacent to the storage area for the sterile instruments, away from the flow of traffic but close enough for quick access.

Nitrogen cylinders, if used, should be stored in a designated unsterile storage location away from heat sources. Cylinders should be secured carefully to prevent them from falling over during storage. It is a good practice to check the remaining pressure on nitrogen cylinders before storing to ensure an adequate supply of gas for the next procedure. Gas cylinders should not be used if their remaining pressure is less than 200 psi.

Preventive Maintenance
With proper use and care, powered surgical instruments can have a long lifespan.

A regular program of preventive maintenance can prolong the life of powered surgical equipment. A preventive maintenance program can be coordinated within the facility or may be contracted through the manufacturer.

To ensure quick access, all instruction manuals should be placed in a binder, along with manufacturers’ contact information. Records of all preventive maintenance, as well as repairs and replacements should be logged and archived as appropriate.

CHOOSING POWERED SURGICAL INSTRUMENTS
New powered surgical instruments are constantly being introduced into the marketplace. Perioperative nurses should be actively involved in the product selection process. Purchasing decisions should be based on objective criteria specific to the function and use of the powered surgical instrument system, along with a clinical trial of instruments that meet identified criteria. Criteria that may be used to evaluate powered surgical instrument systems include the following:

- Effectiveness (including patient outcomes). Determine the types of procedures for which the system will be used.
- Reliability, including frequency of repairs and downtime. To determine functionality, you may want to check with other perioperative nurses who have used the.
- Durability. Are attachments durable or do they need to be replaced frequently? This will increase the operating cost of the system.
- Cost. Cost includes both original purchase price and long-term operating costs (e.g., the cost of replacement attachments or single-use accessories required).
- Comfort. The handpiece should be lightweight and easy to hold, and the cord, hose, or battery should be lightweight.
- Convenience. The instrument should be easy to assemble and disassemble. Attachments should be easy and quick to change.
- Power. The device should be powerful enough to accomplish the task for which it was designed, and operate smoothly.
- Versatility. Can one handpiece accommodate a variety of attachments?
- Ease of maintenance and sterilization. Choose practical powered surgical instruments that can be easily cared for and sterilized in your practice setting.
- Availability of training. Does the manufacturer provide training on this product?

SUMMARY
As a part of the surgical team, perioperative nurses can help ensure that every patient receives safe patient care by working collaboratively with the OR administration, surgical and medical staff, and central services personnel to choose high-quality powered surgical instruments and to ensure that all powered instruments are cared for and handled according to the instructions supplied by the manufacturer.
REFERENCES
POST-TEST

POWERED SURGICAL INSTRUMENTS: COMPONENTS OF SAFE CARE AND HANDLING

Multiple choice. Please choose the word or phrase that best completes the following statements.

1. Compared to conventional hand-held instruments, powered surgical instruments
   a. enable the surgeon to work more quickly.
   b. cause less trauma to surrounding tissues.
   c. decrease surgical time.
   d. all of the above.

2. Powered surgical instruments are used for all of the following except
   a. cutting and fixation of bone.
   b. splitting the sternum.
   c. harvesting skin for grafting.
   d. suturing tissue.

3. All of the following have a rotary action except
   a. femoral reamers.
   b. automatic screwdrivers.
   c. bone rasps.
   d. K-wire drivers.

4. Direct current is the source of power for
   a. pneumatic instruments.
   b. battery-operated instruments.
   c. instruments that plug into wall current.
   d. all of the above.

5. When regulating the gas flow for pneumatic a.
   instruments, the correct pressure should be set
   a. by the manufacturer.
   b. before the instrument is activated.
   c. while the instrument is activated.
   d. before attaching the hose.

6. When not in use, powered surgical instruments a.
   should be placed
   a. on the patient.
   b. on a nonsterile table.
   c. on a Mayo stand or a sterile table that is separate from the sterile field.
   d. any of the above.

7. When decontaminating and cleaning a
   pneumatically powered surgical instrument,
   a. the gas hose should remain attached to the handpiece.
   b. a detergent/disinfectant solution should be used.
   c. the outside should be dried with lint free towels.
   d. all of the above.

8. When packaging powered surgical instruments for sterilization, small, delicate parts should be
   a. protected by placing in appropriate section of container or packaged separately.
   b. left unpackaged.
   c. placed under the instrument to prevent movement during sterilization.
   d. placed loosely in the container to prevent stress and tension on the parts.

9. Criteria for choosing powered surgical instruments include
   a. effectiveness and power.
   b. cost and ease of sterilization.
   c. versatility and durability.
   d. all of the above.

10. The earliest applications of powered surgical instruments were in the field of
    a. neurosurgery.
    b. ophthalmology.
    c. dentistry.
    d. orthopedics.
11. Powered surgical instrument systems typically have the following basic components.
   a. A power source, a hose or cord that connects the power source to the handpiece, and the handpiece.
   b. A power source, a hose or cord that connects the power source to the handpiece, the handpiece, a hand or foot control, and accessory attachments.
   c. A power source, a hose or cord that connects the power source to the handpiece, and accessory attachments.
   d. A power source, the handpiece, and accessory attachments.

12. To protect health care workers from exposure to blood and other potentially infectious material, the Occupational Safety and Health Administration bloodborne pathogens standard requires that employers supply
   a. masks that have eye protection devices.
   b. goggles.
   c. glasses with solid side shields.
   d. all of the above.
POST-TEST ANSWERS

POWERED SURGICAL INSTRUMENTS: COMPONENTS OF SAFE CARE AND HANDLING

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c 01
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c 6
c 5
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