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Processing and Care of Surgical Instruments

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AUTHOR NOTE: THIS LESSON WAS ADAPTED FROM A 2017 PROGRAM FROM AESCULAP INC. AND CYNTHIA SPRY.

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LEARNING OBJECTIVES

1. Describe the types of stainless steel and finishes used in the manufacturing of surgical instruments
2. Identify variables that can cause corrosion, pitting or other damage to surgical instruments
3. Discuss key factors in the processing of surgical instruments

Surgical instruments play a major role in patient safety during procedures because faulty devices can harm a patient through injury or infection. In addition to preventing patient injury, three other advantages to proper care and handling of surgical instruments are increased instrument longevity, a possible reduction in instrument inventory, and potential cost savings.

The manufacturing and care of surgical instruments is a multifaceted process that involves many people, and manufacturing can occur in the U.S. or numerous other countries. Quality surgical instruments begin with the selection of metal to be used in their manufacturing and ends with a comprehensive processing program.

Objective 1: Describe the types of stainless steel and finishes used in the manufacturing of surgical instruments

Stainless steel is comprised of various combinations of carbon, chromium and iron. A small amount of nickel, magnesium and silicone may also be present. The specific combination of these elements determines the quality of an instrument in terms of flexibility, malleability and corrosion resistance. A three-digit number issued by the American Iron and Steel Institute is used to grade steel based on its composition and various qualities. The most common stainless steel used to manufacture surgical instruments is the 300 and 400 series. The 300 series is generally used for non-cutting instruments and devices that require high strength such as heavy retractors. The 400 series is used for cutting and other non-cutting instruments. Both series resist rusting and corrosion with proper care and handling; however, it is important to recognize that stainless steel is not truly stainless. The degree of staining is determined by the composition of the steel and final rinsing. (**See Figure 1**)

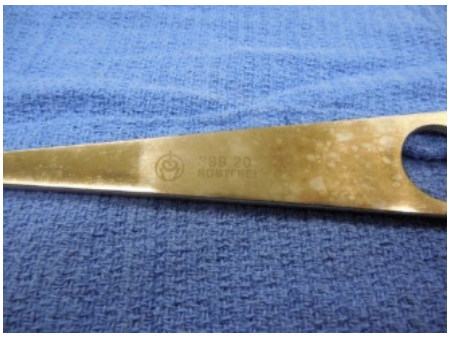

Figure 1

The final steps in instrument manufacturing are passivation and polishing. Passivation is a process where an instrument is dipped into nitric acid to remove carbon and steel particles left behind during manufacturing. When these particles are removed, pitting occurs. Passivation promotes a coating of chromium oxide that protects the instrument from corrosion. Passivation and polishing remove any pitting that may have occurred and create a smooth surface that closes surface pores and can extend the life of the instrument. A porous surface or one where passivation is not present can cause rust. The chromium oxide layer thickens with age and increases resistance to corrosion over time. Protecting the chromium oxide layer is the basis of good instrument care.

There are three types of instrument finishes:

- Highly polished: This is the most common finish. It is shiny, reflects light and resists corrosion.
- Anodized, also referred to as satin finish: This surface is non-reflective.
- Ebony: A black finish that eliminates glare and is used in laser surgery.

Objective 2: Identify variables that can cause corrosion, pitting or other damage to surgical instruments

A stain can typically be removed whereas corrosion is permanent. When pitting, corrosion or rust is observed on an instrument, the device should be removed from service. Dried-on, residual organic matter may appear to be rust and is most often found in box locks. Inspection under lighted magnification should be performed to evaluate the appearance of stains or corrosion and determine which are rust or organic debris.

Potential causes for stains and corrosion

Stains should be removed whenever possible, so the surface underneath the stain can be inspected to determine whether corrosion is present. When stains occur, the cause should be investigated and action should be taken to prevent future staining.

Brown or orange stains may be caused by high-pH detergents, chlorhexidine, and the use of water or steam containing silicon-dioxide or silicates.

Dark brown stains may be caused by low-pH solutions or baked-on blood (which can also cause corrosion).

Bluish-black stains may be caused by reverse electroplating, where instruments made from different metals are sonicated together. Exposure to saline, blood or potassium chloride can also cause bluish-black stains. Saline and blood can cause corrosion as well. When corroded instruments are sonicated with other instruments, existing areas of rust can be transferred to other instruments.

Light and dark water stains or spots may be caused when water droplets slowly evaporate or dry on instruments, and a fine deposit of minerals, such as calcium, sodium and magnesium, is left behind.

Pitting can occur when low-pH detergents and water with a high chloride content are used over an extended period of time. (**See Figure 2**)

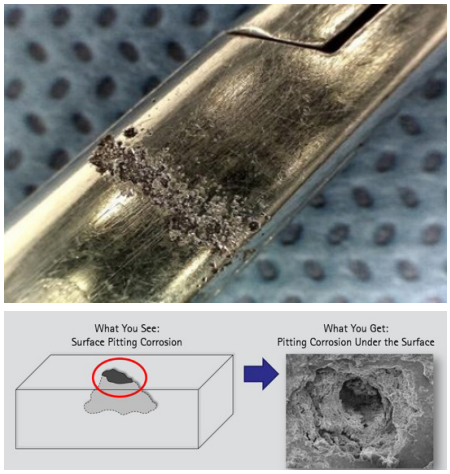

Figure 2

Water and steam quality

Sterile Processing (SP) professionals and hospital Facilities Management personnel need to understand the correlation between water and instrument integrity. The Association of periOperative Registered Nurses (AORN) advises: "Device processing personnel, in collaboration with clinical engineering personnel, should perform a water-quality assessment periodically as well as after major maintenance to the water supply system to determine water quality relative to the requirements as specified in the detergent and cleaning equipment manufacturer's written instructions for use (IFU)."[1] In other words, the device and detergent manufacturers' IFU should be referenced to determine if water quality meets the requirements in the IFU.

Guidelines fom AORN and the Association for the Advancement of Medical Instrumentation (AAMI) state that treated water (e.g., deionized or distilled) should be used for the final rinse when cleaning instruments. Untreated water (tap water) may contain minerals that can cause staining whereas treated water can prevent mineral deposits. Untreated water may also contain endotoxins that, if not removed, can

cause inflammation when deposited onto patient tissue. Rust particles from pipework can be dispersed over instruments and lead to corrosion.

Water and steam containing calcium or manganese can cause lime deposits; corrosion can flourish underneath these deposits. Chlorides can contribute to pitting, and poor-quality steam caused by inadequate boiler treatment can cause boiler additives to be deposited onto instruments during the sterilization process.

Objective 3: Discuss key factors in the processing of surgical instruments

When processing surgical instruments, key steps include point-of-use treatment, transport, preparation, decontamination, general maintenance and inspection, lubrication, preparation and assembly, sterilization and storage. This section discusses these steps in detail.

Point-of-use treatment

The first step in preparing an instrument for processing should occur at the point of use. Point-of-use treatment prevents debris from drying on instruments, making subsequent cleaning less difficult. Blood and tissue that is allowed to dry can become trapped in instrument serrations and box locks or between scissors blades, and it can impact sterilization and function. During surgery the scrub person should wipe, rinse or irrigate blood- and tissue-contaminated instruments with sterile water. Lumens may be flushed with a syringe.

In preparation for transport to the Sterile Processing department (SPD), single-use blades and sharps should be removed and deposited in a designated sharps container. Heavy instruments should be placed on the bottom of the tray or container and more delicate instruments should be placed on top or otherwise protected. Microsurgical instruments should be segregated into separate containers. Ratchets should be opened, and multi-part instruments should be disassembled, if indicated in the manufacturer's IFU. Instruments should be returned to their respective containment devices to keep sets together and reduce the risk of a set being incomplete when packaged.

Instruments should be sprayed with an instrument-treatment spray intended to prevent debris from drying. Instrument-treatment spray IFU as well as instrument manufacturers' IFU should be reviewed to determine any contraindications or restrictions such as the amount of time the spray should be allowed to remain on the instruments.

Transport

Following surgery, all instruments—regardless of whether they were used—are considered contaminated and should be transported in a closed container or enclosed transport cart to the decontamination area as soon as possible after the procedure. The Occupational Safety and Health Administration's (OSHA's) bloodborne pathogens standard requires the containment device to be labeled with a "biohazard" symbol (alternatively, a red bag or red container may be used).[2] Instruments with sharp edges or points should be placed within the containment device, so the edges are protected and processing personnel are not exposed when reaching into the containment device. Instruments may shift during transport and unless they are separated, delicate instruments may become damaged by heavier instruments. Delicate instruments, therefore, should be separated from heavy instruments. Transport carts should be large enough to ensure instruments do not extend over the edge of the shelf, risking being knocked off and damaged (see **Figure 3**).

Figure 3

Preparation

Upon arrival to the decontamination area, instruments should be sorted and prepared for decontamination. The following steps should be performed:

If not already disassembled upon arrival, multi-part instruments should be disassembled.

Ratchets should be opened using stringers, racks or pegs to separate instruments and keep ratchets in the open position during cleaning.

Microsurgical instruments should be protected from damage by placing them in separate containers or otherwise segregating them for cleaning.

Decontamination

Decontamination is the physical or chemical process that renders surgical instruments and equipment that may be contaminated with harmful microbes safe for handling and use.[2] Decontamination protects instrument

preparation and assembly workers who come in contact with medical devices from contracting diseases caused by microorganisms on those devices. In general, decontamination includes cleaning and disinfection.

Decontamination may be accomplished manually or mechanically. Instruments should be processed in a dedicated decontamination workspace, not a sink used for hand hygiene. Care should be taken to follow the IFU for the instrument, detergent, disinfectant, and mechanical cleaning equipment. Some instruments, such as ophthalmic devices, require special handling, and the IFU will provide the necessary processes. Cleaning agents and supplies identified in the device IFU should be used. Unless indicated in the IFU, scouring pads, abrasives and metal brushes should not be used because these can damage the surface or passive layer of an instrument. Soft-bristled, nylon brushes are preferred. Brushes should be long enough to exit the distal end of a lumen and wide enough to contact the sides of the lumen (but not so wide that they collapse upon insertion). SP technicians must remember that if a device is not clean or cannot be properly cleaned, it cannot be effectively sterilized. If debris is not fully removed and is subsequently baked onto the instrument during high-temperature cleaning and sterilization, it can protect bacteria beneath it. Multiple incidences have been documented where bacteria that survived cleaning and sterilization was dislodged into a subsequent patient and caused an infection.[3,4] Decontamination is a complex and critical aspect of instrument processing.

General maintenance and inspection

Upon arrival in the preparation and assembly area, instruments should be inspected and tested for proper function. This inspection process should check for misalignment, malfunction, dull edges or points, bent tips, loose screws, pits, nicks, cracks and corrosion before instruments and equipment are packaged for reuse or storage. When debris is noted on an instrument, that device (as well as all of the instruments sharing the tray) should be returned to the decontamination area for re-cleaning. Instruments that do not function as intended should be tagged for repair or discarded if they cannot be repaired to quality standards. Damaged instruments should be set aside for further evaluation, repair or replacement. Damaged instruments should never be placed into sets, and incomplete sets should not be processed until the damaged instrument has been replaced.

Box locks, serrations and crevices should be carefully inspected for cleanliness. Instruments with cutting edges, such as scissors, Kerrison rongeurs, chisels and curettes, should be checked for sharpness. Hinged instruments, such as clamps and forceps, should be checked for stiffness and alignment of jaws and teeth. Ratchets should close easily and hold firmly, and any instruments with pins or screws should be inspected to ensure they are intact. Plated instruments should be checked for chips, worn spots or sharp edges. Worn spots can rust during autoclaving. Chipped plating can harbor soil, damaging tissue and rubber gloves. In summary, if any problems are noticed during the inspection process, those instruments should be either re-cleaned or sent for repair (depending on the problem observed).

Lubrication

Lubrication, when used correctly and according to the manufacturer's IFU, helps prevent staining, rusting and corrosion of instruments with mechanical parts. Lubrication promotes smooth action of hinged instruments and helps keep devices clean by preventing mineral and protein buildup. A water-soluble, antimicrobial lubricant should be used after each cleaning to penetrate box locks, hinges and crevices; this helps prevent binding and excessive wear. This step should be performed on surgical instruments as needed and on delicate instruments and endoscopes whenever possible. Various lubricants, lubricant sprays, and stain and rust remover products are available today.

Preparation and assembly

The preparation and assembly area of the SPD is best described as the "clean room." After instruments have been cleaned and inspected, they are typically assembled into sets or trays and prepared for sterilization. Instruments should be arranged in sets to maximize exposure to the sterilant, protect the instruments from damage and facilitate setting up the surgical procedure. Stringers or posts should be used to keep ringed instruments open, and instruments should be strung from large to small, with jaws and tips pointing in same direction. Cupped or concave instruments should be positioned in a manner to not collect water. Heavier instruments should be loaded first and kept separate from lighter instruments. Delicate instruments are often packaged in cases specially designed to protect them. Instruments should be packaged and sterilized according to their manufacturers' IFU, which identifies the compatible sterilization modality and required cycle parameters.

Sterilization

Sterilization of medical devices, surgical instruments, supplies and equipment utilized in direct patient care and surgery impacts patient safety and outcomes. Improperly sterilized

or contaminated medical devices can contribute to surgical site infections (SSIs) and pose a serious risk to the patient's safety and welfare. Death may even result from device-associated infections.

Packages, such as pouches, trays and rigid sterilization containers, should not be overloaded. Heavy instruments should be placed on the tray bottom, with lighter and more delicate instruments positioned on top. Microsurgical and othger highly delicate instruments should be packaged separately from more general instruments. The sterilizer should not be overloaded; the user should consult the sterilizer manufacturer IFU for guidance on proper loading.

Storage

Instruments should be stored in a controlled environment with restricted access and handled as little as possible. Storage shelves should be clean and dry. There should be a minimum of four air exchanges per hour, and humidity should not exceed 70%. The more frequently instrument sets are handled the greater the potential for damage. Instrument sets should not be stored on the floor. Storage should be eight to 10 inches above the floor, two inches from outside walls, and not under a sink or area where they may become wet.[5] Fire codes specify minimum clearance between sprinkler heads and stored items, with the typical accepted distance of 18 inches.[6]

ANSI/AAMI ST79: 2017 (with 2020 Amendments), *Comprehensive guide to steam sterilization and sterility assurance in health care facilities*, does not recommend stacking wrapped sets because each stacked set applies pressure to the tray beneath it.[5] Multiple stacked sets can apply excessive pressure to the packaging on the bottom, which can damage the packaging material.[5] A set with a compromised wrapper is of no use to the Operating Room or other procedural areas. *Note: Not all wrapped sets may be stacked. It is important to confirm with the wrap manufacturer's IFU before stacking wrapped sets during transportation and storage.*

Conclusion

Damaged or otherwise malfunctioning surgical instruments can harm a patient through injury or infection. It is essential that all SP technicians understand their devices' composition and the need for consistent, diligent inspection, maintenance and processing to ensure that devices are safe and well functioning for patient use.

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CIS Self-Study Lesson Plan Quiz:
Processing and Care of Surgical Instruments

Lesson No. CIS 294 (Instrument Continuing Education - ICE) · Lesson expires November 2025

1. The manufacturer's instructions for use (IFU):
- a. Provide information on how the instrument is intended to function and be operated
- b. Provide details on how the instrument should be cleaned, disinfected, inspected, and tested for functionality
- c. Does not cover packaging and sterilization of instrument
- d. Must be updated every year

2. Instruments contaminated with blood and tissue should be addressed at the point of use by:
- a. Wiping the instruments with a sterile sponge moistened with saline
- b. Wiping the instruments with a sterile sponge moistened with water
- c. Immersing the instruments in a basin of sterile saline
- d. Flushing lumens above water to create aerosolization

3. Preparing instruments for transport to the Sterile Processing (SP) area includes all of the following steps, except:
- a. Keeping single-use blades and sharps in the same container as the reusable sharps
- b. Placing heavy instruments on the bottom tray or container, with more delicate instruments placed on top
- c. Opening ratchets and disassembling multi-part instruments as indicated in the IFU
- d. Returning instruments to their respective containment devices to keep sets together

4. Instrument decontamination:
- a. Includes cleaning and disinfection
- b. Can be accomplished manually and mechanically
- c. Involves proper use of detergent and disinfectants, in accordance with the manufacturers' IFU
- c. All of the above

5. Which of the following is not a correct statement about instrument storage?
- a. Storage shelves should be kept clean and dry
- b. There should be a minimum of four air exchanges per hour, and humidity should not exceed 70%
- c. Instrument sets may be stored on a floor or underneath a clean and organized sink
- d. Storage should be two inches from outside walls with a minimum clearance of 18" between sprinkler heads and stored items

6. To protect instruments:
- a. Use water, not saline, to wipe instruments during surgery and irrigate lumens
- b. Pretreat instruments with a spray or other product intended to prevent blood and debris from drying on the devices
- c. Separate delicate instruments from heavy instruments during transport
- d. All of the above

7. Which of the following is not a type of stainless steel instrument or finish?
- a. Highly polished
- b. Sterling silver
- c. Anodized/satin finish
- d. Ebony finish

8. Which of the following is correct about instrument stains?
- a. Stains can usually be removed
- b. Stains are usually permanent
- c. Stains cause pit marks under discoloration
- d. Stains cause an instrument to be removed from service and sent for repair

9. Which of the following steps should be performed to ensure instrument integrity?
- a. Referencing the device and detergent manufacturers' IFU to determine if water quality meets the requirements in the IFU
- b. Using tap water for the final rinse when cleaning instruments
- c. Performing water and steam system testing weekly
- d. Ensuring that those in procedural areas are properly cleaning and sterilizing instruments at the point of use

10. Instrument inspection includes:
- a. Inspecting for retained debris, staining, corrosion, jaw/tooth alignment, cracked box locks, bent tips, loose screws, stiff movement and other damage
- b. Inspecting for nicks, burrs, cracked inserts and broken tips on cutting instruments
- c. Examining joints and instrument serrations for debris and then lubricating the devices according to their IFU
- d. All of the above

11. Instruments that do not pass inspection should:
- a. Involve immediate communication between the SP technician and surgeon/caregiver to determine the cause
- b. Be placed in a biohazardous waste container
- c. Be removed from service and tagged for repair
- d. Still kept in use as long as the damage is slight and will not jeopardize patient safety

12. Which type of stainless steel is used to make instruments with cutting edges?
- a. 300 series
- b. 400 series
- c. Anodized stainless steel
- d. Ebonized stainless steel

13. Which is the final step in a surgical instrument's manufacturing process?
- a. Polishing
- b. Milling
- c. Forging
- d. Sharpening the cutting edge

14. Dark brown stains may be caused by:
- a. Loss of the passivation layer
- b. High-pH water
- c. Chlorine
- d. Baked-on blood

15. Instrument lubrication:
- a. Doubles the life of an instrument
- b. Should be performed at the point of use
- c. Can be skipped only if turnaround time is limited
- d. Helps prevent staining, corrosion and mineral buildup

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