Instrument Staining: What Causes It and How to Prevent It

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Instrument Continuing Education (ICE) lessons provide members with ongoing education in the complex and ever-changing area of surgical instrument care and handling. These lessons are designed for CIS technicians, but can be of value to any CRCST technician who works with surgical instrumentation.

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LEARNING OBJECTIVES

1. Discuss the effect staining has on instrumentation
2. Explain the causes of instrument stains
3. Review the most common instrument stains and their causes and corrective actions

Surgical instrument spotting, staining and corrosion are serious problems in many healthcare facilities. These problems can be avoided if careful attention is given to the method of instrument processing and possible causes of staining are understood. This lesson will explore the most common stains, as well as what to look for and possible causes and cures.

Objective 1: Discuss the effect staining has on instrumentation

Spotting, staining and corrosion can impair surgical instruments' function. Corrosion in the box lock area of an instrument, for example, may cause the instrument not to open or can cause instruments, such as scissors, not to open or close smoothly, leading to poor cutting action and tissue damage to the patient.

Instruments with a higher carbon content like scissors and rongeurs could become dull from pitting and corrosion, which, in turn, can cause poor cutting and rusting of the cutting area. These instruments may also break during the operative procedure. Spotting, staining and corrosion also interfere with the sterilization process. Corrosion can protect some spores during the sterilization process, causing an unsterile instrument to be used on a patient.

Corrosion results in a shortened instrument life. This results in increased cost due to repair and replacement, as well as frustration for customers and the potential for poor patient outcomes. Many times, instrument staining can be stopped through investigation of the processing cycle and by correcting actions that led to the staining.

The most common problems with instruments are discoloration, pitting, staining, spotting or rusting. Trained instrument technicians can easily identify staining problems during routine instrument inspection. Finding and resolving the cause takes diligence and careful review of the processes in which the instrument has been exposed. While most technicians believe that staining, spotting and corrosion originate in the decontamination area, this is not necessarily true. These problems can

occur in the instrument assembly, packaging and sterilization areas as well.

Objective 2: Explain the causes of instrument stains

There are many reasons instruments become stained and/or corroded, and instrument technicians must pay close attention to how the instruments appear each time an instrument is handled.

Spots are loose deposits or semi-adherent deposits present on the surface of instruments; these can usually be wiped off relatively easily with a cloth. If the spots are removed, instruments are usually not physically or chemically affected. Staining is usually identified by a discoloration on the instrument. Often, the color of the stain will help inform of its likely cause. Unlike spots, most stains cannot be easily wiped from an instrument.

What follows are general causes of instrument staining during the processing cycle:

- **Use of inappropriate solutions.** Exposure of stainless-steel instruments to either chlorine or sodium chloride is one of the most harmful things that can be done to the devices; however, other solutions commonly found in the facility can be just as damaging to instruments. The following solutions should never be used when processing instruments:
  - » Hydrogen peroxide;
  - » Ammonia;
  - » Iodine or iodine products (e.g., betadine);
  - » Bleach; and
  - » Carbolic or hydrochloric acid.

  There are many other common solutions that can be harmful to instruments, so it is imperative that the instrument's instructions for use (IFU) are carefully read before using any chemical solution on an instrument.

Figure 1: Blood dried on instrument

- **Poor instrument handling.** Improper handling (e.g., dumping instruments in a sink or on a preparation table) can damage the instrument's passivation layer. Instruments that have not been properly prepped after the procedure allow blood and body fluids to dry on the instrument, which also damages the passivation layer. Rough handling of instruments in any way is also harmful. Improperly drying instruments is also very damaging to most instruments. Once this protective passivation layer is damaged, instruments will more easily spot, stain or corrode.

- **Cleaning chemicals.** Cleaning chemicals can cause spots if they are not hard-water tolerant or are incorrectly mixed. Incorrectly mixed cleaning chemicals can attack the instrument's passivation layer. This causes the layer to thin or disappear, which allows the instrument to rust or corrode faster.

  Using a highly alkaline detergent and then neutralizing that detergent with an acid detergent can also quickly damage an instrument if these detergents are not used or rinsed properly.

  Soaking instruments longer than is recommended by the manufacturer will damage instruments, especially those with a high carbon content.

- **Abrasive cleaners/tools.** Using highly alkaline or highly acidic cleaners, steel wool and/or metal brushes is not recommended for instruments. Soap-impregnated scouring pads and scouring cleaners, unless specifically recommended by the instrument manufacturer, should never be used. Even though these items will remove stubborn stains or material that is dried and difficult to remove, they will damage medical devices.

  Adhesive and stain removers, if used incorrectly, will also damage instruments by allowing staining and pitting to begin to occur.

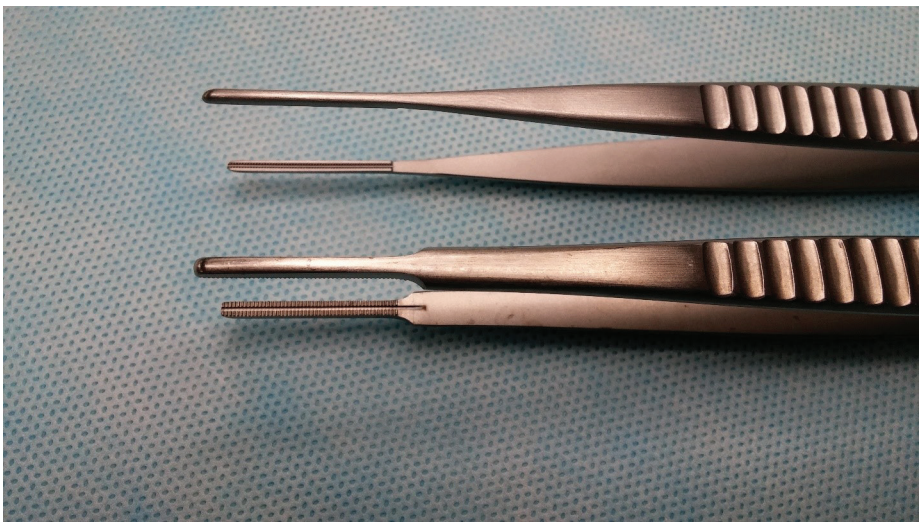

Figure 2: Pitting

Figure 3: Rusted instrument

- **Poor water quality.** Water quality should be periodically monitored to eliminate any impurities. Water mineral deposits, chemical residues and poor soil removal can cause spotting. Copper, iron and zinc deposits in the water should also be monitored to prevent staining. Rinsing instruments in hard (not treated) water will quickly spot and stain instruments.

- **Improper loading of cleaning equipment.** Overloaded trays, manifolds or sterilizer carts can cause spotting, staining and corrosion.

- **Mixed metals.** Mixing instruments made of different metals in either the ultrasonic cleaner or the sterilizer can cause discoloration and staining, which can lead to rusting.

- **Linen.** Professional laundries use an acetic rinse during the laundry process. Laundry residues on reusable wraps and linen can be reactivated by high temperature and humidity. Surfactants used to treat the water or used as part of the laundry process can also stain instruments if the linen is not completely rinsed.

- **Disinfectants.** The misuse of disinfectants can damage instruments. This can occur when instruments are allowed to soak too long in a disinfectant solution. It is important to follow the label instructions on disinfectants; this includes concentrations and exposure times. Cold sterilization chemicals that are not properly used or rinsed can also cause instrument staining.

- **Steam quality.** Steam quality should be periodically checked to ensure there are no impurities, and steam traps should be changed as recommended. Flushing steam lines after a major repair and using steam filters may help keep steam quality within the recommended guidelines. Water mineral deposits, chemical residues, steam residues, and poor soil removal can cause spots on instrumentation in the sterilizer. Steam sterilizers should be checked often and maintained according to the sterilizer manufacturer's IFU to ensure a well-functioning drying cycle.

Stains can be removed with stain removers or buffed out, although true rust will cause permanent damage to surgical instruments if not addressed in a timely manner. To protect the facility's investment, it is important to always follow the instrument and equipment manufacturer's IFU. The facility's instrument repair technician should also be consulted for best practices and expert clarification of the type of stain noted.

Objective 3: Review the most common instrument stains and their causes and corrective actions

During each step in the instrument processing cycle, it is important to check the instruments for any type of discoloration or spotting. Also, it is always essential to investigate the

discoloration to identify the cause and implement the necessary corrective action to help keep the instruments in quality working order. The following are signs of stains, spotting and corrosion commonly seen during instrument reprocessing. The most common corrective action for each category is also listed.

Rust color (orange to reddish or brown stains). Checking the stain with an eraser will help determine whether the discoloration is rust or a stain. If the color rubs off with no pitting below the coloring, it is usually caused by dried blood, betadine residue, the use of high alkaline chemicals or cold sterilant chemicals. Sometimes, this discoloration can be caused by residue in reusable linen. Using a neutral-pH detergent, rinsing the instruments in warm water and properly using a stain remover (if allowed in the IFU) may remedy this issue. It is important to check the linens for residues and to check the water for high iron content.

If the stain is determined to be rust/corrosion, the causes can be: damage to the passivation layer; cleaning and sterilizing instruments made of different metals together; dried blood; detergent residues; poor water quality; residues in reusable linen; or allowing instruments to remain wet. Instruments made of different metals should not be mixed in the same tray. Neutral-pH chemicals should be used, and then rinsed according to the manufacturer's IFU. It is also essential to ensure instruments are carefully dried before placing them into a sterilizer (check sterilizer dry cycles). Instruments with even small quantities of rust should not be used until they are repaired.

Spotting (light or dark color spots). Steam and water impurities are the most common causes of spotting. Be sure instruments are rinsed in treated water. Also, reusable linens should be checked for residues. Technicians should ensure the washer and sterilizer dry times are operating according to the manufacturers' specifications.

Pitting. Exposure to harsh chemicals (e.g., saline) and dried blood, and instrument misuse are common causes of pitting. It is essential to only use chemicals on instruments that have been approved for use by the instrument's manufacturer. Using approved moisturizing/wetting agents (e.g., enzymatic products) at the point of use will help prevent instrument pitting. When pitting occurs, the passivation layer has been damaged; pitted instruments should not be used until repaired or replaced.

Black stains. Exposing instruments to bleach or ammonia or using multiple chemistries without properly rinsing between each chemical can cause black stains. When black stains are noted on instruments coming out of a washer, it is important to check for overcrowding of instruments, and also to check the rinse cycle to ensure the chemicals are being properly removed.

Rainbow coloration. Rainbow coloration is caused by high heat; therefore, it is essential to check the temperature on the sterilizer.

Purple/black coloration. Exposure to chlorine or ammonia can cause instruments to turn purple or black, as can excessive amines in the steam lines. It is important to check chemical use in each area of both the Sterile Processing department and the user departments. Steam lines should be cleaned, and Facilities should be consulted regarding boiler chemicals.

Blue/black coloration. Processing unlike metals together in either an ultrasonic cleaner or sterilizer can cause blue/black discoloration. Instruments comprised of different metals should always be separated and processed separately.

Blue/grey coloration. Blue/grey coloration is typically caused by improper use of a cold sterilant. Carefully following the sterilant manufacturer's IFU for proper use is essential, as are soaking only for the recommended amount of time and rinsing with treated water.

Yellow/brown coloration. Yellow/brown stains are typically caused by protein residues from instruments that haven't been properly cleaned. To help facilitate proper cleaning, ensure instruments are properly treated at the point of use.

Conclusion

Surgical-grade instruments are a major financial investment for any healthcare facility. If instruments are properly cared for, they will last many years. Staining, spotting and corrosion can drastically shorten the lifespan of these expensive devices.

Instrument technicians are challenged with the care of instrumentation, even though many other departments may handle the devices. Careful inspection at each step in the instrument processing cycle will help identify problems before the instrument becomes permanently damaged. Knowing the most common causes of instrument staining, corrosion and spotting - and correcting the cause of this damage early - will help preserve surgical instruments for many years to come.

CIS Self-Study Lesson Plan Quiz -
Instrument Staining: What Causes It and How to Prevent It

Lesson No. CIS 276 (Instrument Continuing Education - ICE) • Lesson expires November 2022

1. It is important to stop spotting, staining and corrosion on instruments because their presence can:
a. Shorten the instrument's life
b. Cause the instrument to become dull
c. Interfere with the sterilization process
d. All the above

2. Instrument corrosion:
a. Does not harm the instrument
b. Shortens the life of an instrument
c. Can be removed with a soft, dry cloth
d. Is only caused by harsh chemicals

3. Spotting is:
a. A major cause of rusting
b. Loose or semi-adherent stains on the instrument
c. Identified by a purple/black color
d. Caused by using bleach

4. Poor instrument handling can lead to instrument staining.
a. True
b. False

5. Which chemical should not be used on instruments because it can cause damage?
a. Hydrogen peroxide
b. Betadine
c. Saline
d. All the above

6. Cleaning chemicals can cause instrument staining when:
a. They are not properly mixed
b. The instruments have been soaked too long
c. The chemical has an acidic pH
d. All the above

7. Adhesive removers will not harm instruments if the instructions for use state they can be used.
a. True
b. False

8. The use of reusable towels in instrument sets may damage instruments if the towels are not properly rinsed.
a. True
b. False

9. A red, orange or brown stain may be:
a. A sign that mixed metals were processed together
b. Caused by the improper use of a disinfectant
c. Rust or dried blood residue
d. None of the above

10. Improper loading of cleaning and sterilization equipment can cause staining because of:
a. Poor rinsing
b. Poor drying
c. Poor cleaning
d. All the above

11. Rainbow-colored stains mean:
a. The instrument was not rinsed properly
b. The instrument was soaked in saline
c. The sterilizer temperature was too high
d. Protein residue was left on the instrument

12. Improper use of a cold sterilant will cause which color of stain?
a. Blue/grey
b. Yellow/brown
c. Rust colored
d. Rainbow

13. Protein residues are identified by the presence of which color?
a. Rainbow
b. Black
c. Yellow/brown
d. Purple/black

14. Instrument pitting can be caused by:
a. Saline
b. A damaged passivation layer
c. Bleach
d. All the above

15. If an orange stain rubs off the instrument, it is probably:
a. Rust
b. Dried blood
c. Spotting
d. All the above

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