CIS SELF-STUDY LESSON PLAN

LESSON NO. CIS 228
(Instrument Continuing Education-ICE)

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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.

You can use these lessons as an in-service with your staff, or visit www.iahcsmm.org for online grading at a nominal fee.

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LEARNING OBJECTIVES:

1. Describe titanium and its physical characteristics
2. Review some applications for the use of titanium in surgical instruments
3. Discuss advantages of titanium instrumentation and implants
4. Provide guidelines for effective repair of titanium instruments
5. Provide cost comparisons of titanium and other instruments
6. List special needs and concerns for cleaning, decontamination and sterilization of titanium instruments

Titanium (element symbol Ti) is a metal. It is among the first metals to have been discovered (1791) and it was one of only 27 elements on an early periodic table in the early 1800s (by contrast, a modern periodic table identifies 118 elements). It is the ninth most abundant element and is readily found in several countries, including the United States, Canada, Australia, South Africa, and Russia. It is readily found in most living things, and in rocks, soil and bodies of water. In spite of its early discovery, production of pure metallic titanium did not begin until 1910.

All about Titanium

Titanium has a silvery grey to white appearance and is categorized as a transition metal. These metals are extremely durable because they are very hard and strong, and have high melting points.

Titanium is also known for its low density, which refers to the overall mass or weight of the object. For example, titanium has a density value of 4540, compared to plastics that range between 850 and 1400, and stainless steel with a value between 7480 and 8000.[1]

Titanium is very resistant to corrosion and, compared to its alternatives, has the highest strength-to-weight ratio. This means an instrument made of titanium is much stronger than its lightweight appearance and mass (to better understand this, consider a bridge: its weight is compared to the amount of weight that can be carried or supported without collapsing).

Corrosion resistance and strength-to-weight ratio are important benefits and, as a result, titanium is commonly used in the manufacturing of parts in many industries, including aerospace, automotive, sports, and jewelry-making. This "space-age metal" also has numerous applications for healthcare—in prosthetics, orthodontics, dental and orthopedic implants, and surgical instrumentation.

Titanium Instruments

Titanium instruments are up to 45% stronger than their stainless steel counterparts and can be up to 50% lighter. This is a prime reason they are preferred in ophthalmology and cardiology procedures. For example, a titanium instrument can provide a highly textured handle for a surgical instrument that offers a secure grip; however, because it is much lighter, it does not cause hand fatigue for surgeons as they perform delicate or lengthy procedures.

Titanium has another quality that makes it very appealing. It offers improved tactile (sense of touch) responses for the surgeon. This allows an increased sensitivity between a titanium instrument being used and the surgical site. The resistance or pressure the

surgeon applies to the instrument is much more evident and, as a result, the surgeon does not clamp down too tightly. This, in turn, helps to avoid potential patient injury and/or vessel trauma.

Titanium surgical instruments typically take on a blue color, but other colors are possible. This is an advantage because CIS technicians must be able to identify titanium instruments and separate them from those made of other metals during reprocessing. The coloring also gives the instruments a non-glare surface. Most titanium instruments have a matte (dull), rather than mirror, finish and this reduces the glare and reflection from surgical lighting and head lamps.

Its chameleon-like properties allow for easy coloring by anodizing and oxidation. "Titanium reacts with oxygen to form a clear oxide, TiO_2. This clear oxide filters out light waves and produces brilliant colors. As the thickness of oxide varies, so will the color. Oxides form naturally on titanium, leaving the metal a gray color, but applied heat and/or electrochemical treatment will increase the oxide thickness to produce a spectrum of color similar to a rainbow. This same filtering effect can be seen in colors on soap bubbles."[2]

Central Sterile Supply Department (CSSD) technicians often notice that the color of titanium instruments varies. Original color differences are caused by the anodizing process during manufacturing, which is done for several reasons, two of which are to increase corrosion resistance and durability.

Many metals can be anodized, always with the purpose of improving the protective layer. Anodizing uses simple chemical liquids and an electrical current. The combined process speeds up the naturally-occurring oxidation of the metal. Aluminum is anodized by this method, but it also introduces dyes to obtain color. Titanium anodizing and coloring does not require dye. Rather, the desired color results from the length of the process which thickens the oxide layer. Color variations are also caused by the specific alloys used in the instruments' manufacturing. Shading and loss of color in existing instruments may occur after repeated sterilization cycles; however, they do not indicate a flaw or defect in the instrument, nor will these changes affect instrument performance.

Titanium Implants

Titanium's low density and lightweight features are especially important considerations for surgical implants. Cranial mesh, facial and ocular reconstruction plates, and screws are among the many implant uses for titanium-based items. Its light weight makes titanium the perfect material for other implants, including hip, knee and shoulder joints.

Titanium is very useful in the manufacturing of implants because it is extremely biocompatible. That is, it is essentially non-toxic and non-allergenic and, therefore, will not be rejected by the body. Patients requiring reconstructive surgeries or joint replacements also benefit because titanium implants are non-magnetic and safe for Magnetic Resonance Imaging (MRI). The resilience and strength of titanium implants prevent the need for joint revisions that are more commonplace with other metals. In fact, titanium's rigidity and durability are more than twice that of bone. This means that, for hips and knees, the implant bears more of the weight, and the adjoining bone has a greatly reduced weight load.

Titanium implants can remain in place for up to 20 years (more than 30 years in the case of dental implants) because they integrate so effectively into the bone by osteointegration, the process by which mature bone is deposited directly on implant material.

Surgical implantation is often associated with the risk of infection. Approximately 10-15% of these complications are caused by bacterial-induced infections from biofilm that form on the implant's surface.[3] Note: A biofilm prevents agents such as sterilants, disinfectants and antibiotics from reaching microorganisms to destroy them. One strategy is to modify the protective oxide layer of the titanium implant. For example, if that layer can be combined with other substances, it is possible that a reduction in biofilm formation can occur.

CSSD professionals should be encouraged by any progress in biofilm reduction because it directly impacts their role in the preparation and sterilization of the surgical instrumentation used to install the implants. The CSSD profession is critically concerned about the processing of instruments used for implantation procedures, and members are aware of their role in a successful surgery. Any and all advancements that enable these procedures to be more successful are very important.

Titanium Instrument Repair

Even though titanium is hard-wearing and resilient, instrument repair is inevitable. Proper care will prolong repairs, but titanium instruments can be misused and abused in the same ways as instruments made of other metals. Titanium instruments can be repaired at an on-site, in-house repair shop, by a mobile instrument repair service and, sometimes, by the manufacturer. Titanium scissors can be sharpened, general diamond dusting can be re-applied to needle holders, and locks can be repaired and replaced. On the other hand, broken posts, cracked ends and damaged springs cannot be repaired on titanium or other similar instruments.

Titanium Instrument Costs

The benefits of titanium instruments come at a higher price than the purchase price of their counterparts, and this additional cost must be considered when purchasing decisions are made. The extent of additional cost varies depending on the specifics, details and precision applicable to the particular instrument.

In general, there is an average 20% increased cost for titanium instruments compared to others of the same type. Figure 1 shows cost examples (Note: The cost comparison was made in December, 2010).

Figure 1: Cost Comparison of Stainless Steel and Titanium Instruments

Description	Stainless Steel	Titanium
Adson Tissue Forcep	$ 135	$175
Singley Forcep	$ 515	$665
Debakey Forcep	$ 625	$775
Satinsky Clamp	$ 625	$995

Care and Handling Concerns

In general, the pre-cleaning at point of use, general cleaning and decontamination procedures, and terminal sterilization methods are the same for titanium and stainless steel instruments. However, there are factors besides metal composition, including the delicacy and intricacy of the instrument, which must be considered. For example, many manufacturers of ophthalmologic instruments warn against washing in an ultrasonic cleaner; however, the purpose relates more to providing protection for diamond blades and/or delicate tips than the fact that the instrument is made from titanium. Washer/Disinfectors/Decontaminators are an effective and acceptable means for decontamination. Caution must be exercised so that delicate titanium instruments are not placed on the bottom of instrument carriers because they then bear the weight of heavier instrumentation and devices.

Caustic solutions, disinfectants and abrasive cleaners must be avoided for all instruments, including titanium, and blood, debris or bodily fluids should not be allowed to dry on any instruments. Approved foam pre-treatment and enzyme solutions are compatible with titanium. The standard guideline for separation of metals through the decontamination process should be observed to avoid metal migration. You can see from these examples that there are not many extra requirements for maintaining an inventory of titanium instruments.

In Conclusion

Aside from additional purchase costs, facilities considering use of titanium surgical instruments will not need to make numerous processing changes, or use additional equipment or cleaning solutions.

Titanium surgical instruments can be readily handled in any size facility that chooses to utilize them; however, CSSD personnel must know and understand the importance of their proper care and handling to maintain the investment that has been made. When they do, a facility's titanium inventory will add benefits for successful surgeries, satisfied surgeons and positive patient outcomes.

Endnotes:

1. *Metals and Alloys – Densities*, Retrieved June 2011, from *www.engineeringtoolbox.com/metal-alloys-denisties-d_50.html*
2. *Titanium Information,* Retrieved June, 2011, from *www.titaniumart.com/titanium-info.html*
3. Gasik, Michael (2011, May 30), *New Materials and Coatings for Implants with Enhanced Resistance to Infections*, Retrieved June 2011, from *www.aalto.fi/en/current/news/view/2011-05-30/*

Information Sources for Titanium Instruments:

Aesculap Surgical Instruments

Duckworth & Kent

Scanlan International

Wexler Surgical

CIS Self-Study Lesson Plan Quiz

(Instrument Continuing Education-ICE)

Lesson No. CIS 228: Titanium Instruments

Questions (circle correct answer):

1. Titanium instruments are up to _____ percent lighter than their stainless steel counterparts.
   a. 20
   b. 30
   c. 40
   d. 50

2. Which feature of titanium relates to an increased sensitivity between the instrument and the surgical site?
   a. Its strength
   b. Its improved tactile response
   c. Its weight
   d. Its color

3. The color of titanium is caused by:
   a. Anodizing
   b. Oxidation
   c. Its low density value
   d. A and B above
   e. All the above

4. A reason to anodize titanium instruments, during their manufacturing is to:
   a. Increase corrosion resistance
   b. Make them more durable
   c. Make them a unique color
   d. A and B above
   e. All the above

5. Changes in the color of titanium instruments _____ indicate a flaw or defect.
   a. Do
   b. Do not

6. The light weight of titanium implants makes them ideal for transplants.
   a. True
   b. False

7. Instruments made of titanium are biocompatible, which means they:
   a. Do not rust for years
   b. Can be replaced as often as necessary
   c. Will not be rejected by the body
   d. Require processing with extended sterilization cycles

8. The rigidity and durability of titanium is more than _____ times that of bone.
   a. 2
   b. 4
   c. 8
   d. 10

9. Biofilm prevents sterilants and other agents from reaching bioorganisms and destroying them.
   a. True
   b. False

10. Titanium instruments can be repaired by:
    a. The manufacturer
    b. On-site repair shops
    c. Mobile instrument repair services
    d. B and C above
    e. All the above

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11. On average, titanium instruments cost _____ percent more than instruments of the same type manufactured from another metal.
    a. 10%
    b. 20%
    c. 30%
    d. 40%

12. Titanium instruments are delicate and should not be processed in a washer/disinfectant/decontaminator.
    a. True
    b. False

13. Which should be avoided when processing titanium instruments?
    a. Caustic solutions
    b. Disinfectants
    c. Abrasive cleaners
    d. All the above

14. Titanium instruments can be sharpened.
    a. True
    b. False

15. Which <u>cannot</u> be repaired on titanium instruments?
    a. General diamond dusting (needle holders)
    b. Locks
    c. Broken posts
    d. All of the above are repairable

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