Sterilization of dental instruments

• **Sterilization:** Sterilization involves any process, physical or chemical that will destroy all forms of life, including bacterial, fungi, spores and viruses.

• **Disinfection:** It is the process of using an agent that destroys germs or other harmful microbes or inactivates them.

• **Antisepsis:** It is the destruction of pathogenic micro-organisms existing on the living tissue.

Center for disease control and prevention (CDC) classified the instrument into critical, semicritical and noncritical depending on the potential risk of infection during the use of these instruments. These categories are also referred to as Spaulding classification (by Spaulding in 1968) as shown in the table below:

Spaulding's classification of instruments

Category	*Definition*	*Examples*	*Method of handling*
Critical	• Where instruments enter or penetrate into sterile tissue, cavity or blood stream	• Surgical blades and instruments • Surgical dental bur	• To be discarded whenever possible • Sterilized after every use
Semicritical	• Which contact intact mucosa or nonintact skin	• Amalgam condenser • Dental handpieces • Mouth mirror • Saliva ejectors	• Sterilized after every use • High level of disinfection
Noncritical	• Environ-mental surface which contacts infact skin	• Pulse oximeter • Stethoscope • Light switches • Dental chair	To be disinfected between every patient

Methods of Sterilization

1. Autoclave/Moist Heat Sterilization.
   a. Downward (gravitation) displacement sterilizer (non-vacuum).
   b. Steam sterilizers (vacuum).

2. Dry Heat Sterilization/Hot Air Oven.
3. Chemical Vapor Sterilization/Chemiclave.
4. Ethylene Oxide Sterilization (ETOX).
5. Hydrogen Peroxide Plasma.
6. Irradiation.
   a. Ionizing radiation.
   b. Non Ionizing radiation.

1. Autoclave/Moist Heat Sterilization.

Autoclave involves heating water to generate steam in a closed chamber resulting in moist heat that rapidly kills microorganisms. It requires 15 minutes at 121° C and 15 lbs pressure to sterilize the instruments. It can be reduced to 7 minutes if the temperature is elevated to 134° C at 30 lbs pressure.

Advantages:

1. Time efficient.
2. Good penetration.
3. Effective method for sterilizing cloth surgical packs and towel packs.
4. Instruments can be wrapped prior to sterilization.

Disadvantages:

1. Blunting and corrosion of sharp instruments.
2. Damage to rubber goods (at high temperature).

2. Dry Heat Sterilization/Hot Air Oven.

Here sterilization involves heating air (at 160° C for 30 minutes) which transfers energy from air to the instruments.

Advantages:

1. No corrosion in carbon-steel instruments and burs.
2. Maintains the sharpness of cutting instruments.

3. Effective and safe for metal instrument and mirrors.
4. Low cost of equipment.
5. Instruments are dry after cycle.

Disadvantages:

1. poor penetrating capacity.
2. High temperature may damage rubber or plastic goods.
3. Instruments should be dried before placing them in sterilization.

3. Chemical Vapor Sterilization/ Chemiclave.

It is similar to steam sterilizers except it use special chemical solution to be heated in a closed chamber, producing hot chemical vapors that kill microorganisms. Chemiclave operates at 131° C and 20 lbs pressure for about 30 minutes. Eg., Formaldahyde and alcohol.

Advantage:

Eliminates corrosion of carbon steel instruments, burs and pliers.

Disadvantages:

1. Instruments sensitive to elevated temperature are damaged.
2. Sterilization of textiles, a fabric or paper towel is not recommended.
3. Dry instruments should be loaded in the chamber.

4. Ethylene Oxide Sterilization (ETOX).

Ethylene oxide is highly penetrative, noncorrosive gas above 10.8°C with cidal action against bacteria, spores and viruses.

Advantages:

1. It leaves no residue.
2. It is a deodorizer.
3. Good penetration power.
4. Can be used at a low temperature.
5. Suited for heat sensitive objects, e.g., plastic, rubber, etc.

Disadvantages:

1. High cost of the equipment.
2. Toxicity of the gas.
3. Explosive and inflammable.

5. Hydrogen Peroxide Plasma.

It is a process by which dental instruments sterilized by vaporized hydrogen peroxide solution which initiates the inactivation of microorganisms. There are two types of devices that evaporate hydrogen peroxides at which they are; Sterrad 50 (takes 45 min.) and Sterrad 100 (takes 72 min.).

6. Irradiation.

a. Ionizing radiation. e.g. X-rays, gamma rays and high-speed electrons.

b. Non-ionizing radiation. e.g. ultraviolet light and infrared light.

Boiling Water

Boiling water produces a temperature of 100°C at normal atmospheric pressure. Usually 10 minutes exposure at this temperature is required to kill most of the bacteria and some viruses (including HIV and HBV). But even prolonged time exposure does not kill many viruses. Thus, boiling water is not suggested for sterilization of tissue penetrating instruments.

Oil

Hot oil baths requires at least 15 minutes of submersion at temperature of 175°C for sterilization. It has some disadvantages such as; poor penetration and difficult to remove from instruments.

Disinfectant

Levels of Disinfectant:

1. High-level Disinfectant (Aldehyde Compounds; formaldehyde and gaturaldehyde).
2. Intermediate-level (Phenolic compounds).
3. Low-level Disinfectant (Alcohols; ethanol and isopropyl).

Antiseptics

1. Alcohols: ethanol and isopropyl.
2. Aqueous Quaternary Ammonium Compounds: benzalkonium chloride (Zephiran).
3. Iodophor Compounds: Iodine.
4. Chloride Compounds: sodium hypochlorite and chlorine dioxide.
5. Diguanides: Chlorhexidine.

There are some sterilization methods and disinfectants are recommended for some instruments as listed in the following tables:

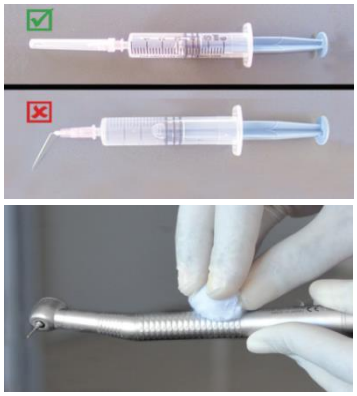
Sterilization and levels of disinfection along with their effects, methods and uses

Method	*Effect*	*Method*	*Used for*
Sterilization	Destroys all microorganisms including spores	Moist Heat, Dry heat, ETOX, glutaraldehyde, H_2O_2, glutaraldehyde with phenol	For critical and semicritical items
High-level disinfection	Destroys all microorganisms but not necessarily spores	Glutaraldehyde, hydrogen peroxide	Semicritical items
Intermediate-level disinfection	Destroys most of bacteria, inactivate *Mycobacterium bovis* but does not kill spores	Chlorine containing products, iodophors, quarternary ammonium compounds	Non-critical surfaces
Low-level disinfection	Destroys vegetative bacterias. Does not inactivate *Mycobacterium bovis*	Iodophors, quarternary ammonium compounds, phenols	Non-critical surfaces

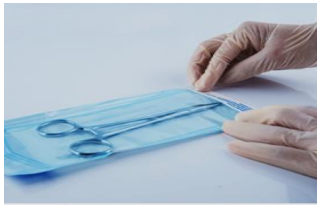
Types of instruments and recommended sterilization method

Instruments	*Method of sterilization*
Stainless steel operative instruments	Autoclave
Endodontic instruments	Autoclave
Carbon steel instruments	Dry heat or chemiclave
Dental burs or abrasives	Dry heat or chemiclave

Tips for sterilization and disinfection of dental unit and instruments.



1. High-level disinfection is used mainly for plastic items that enter the mouth and that cannot withstand heat sterilization.
2. 2 % glutaraldehyde (Cidex), requires immersion of 20 minutes for disinfection; and 6 to 10 hours of immersion for sterilization.
3. Never handle sharp instruments by the working end.
4. Disposable needles, scalpels, or other sharp items should be placed intact into puncture-resistant containers before disposal.
5. It is recommends that all dental workers be vaccinated for HBV, H5N1 influenza virus' (bird flu virus), H1N1influanza virus (swine flu virus), measles, mumps, rubella, and tetanus.
7. Pre-soaking of instruments in a perforated basket contained disinfectant or detergent will facilitate cleaning process.
8. Dental unit surfaces should be disinfected with a suitable chemical germicide such as: phenolics, iodophors (iodine), and chlorine compounds.
9. 1/4 cup of sodium hypochlorite to 1 gallon of water is effective on environmental surfaces that have been cleaned of visible contamination.



Reference:

Textbook of operative dentistry. Nisha Garg and Amit Garg. (2015).