

Sterilization Protocols in Dentistry – A Review

Lakshya Rani¹, Dr.Pradeep²

1st Year BDS¹, Assistant Professor²

Department of Conservative dentistry, Saveetha Dental College, Chennai

INTRODUCTION:

Sterilization (or sterilisation) is a term referring to any process that eliminates (removes) or kills (deactivates) all forms of life and other biological agents (such as viruses which some do not consider to be alive but are biological pathogens nonetheless), excluding prions which cannot be killed, including transmissible agents (such as fungi, bacteria, viruses, prions, spore forms, unicellular eukaryotic organisms such as plasmodium, etc.) present in a specified region, such as a surface, a volume of fluid, medication, or in a compound such as biological culture media. Sterilization can be achieved with one or more of the following: heat, chemicals, irradiation, high pressure, and filtration. Sterilization is distinct from disinfection, sanitization, and pasteurization in that sterilization kills, deactivates, or eliminates all forms of life and other biological agents. Today's busy dental practices face a serious challenge: to maintain or increase productivity while ensuring that patient safety remains a top priority. At times, these may seem like incompatible goals. Advances in dental processing equipment, however, have empowered practices to develop safer processes while realising efficiencies and ultimately, saving money. A cleaning and sterilization process that meets ADA and CDC guidelines is vital to an effective infection control program. (1) Streamlining of this process requires an understanding of proper methods, materials, and devices. Many methods of instrument reprocessing are available. Use of a complete system that encompasses and fulfills all elements that are critical maximizes efficiency and minimizes risks. Closed cassette systems provide a more efficient and safer way to process, sterilize and organize instruments in a dental office - these eliminate manual steps during instrument reprocessing such as hand scrubbing and time-consuming sorting of instruments, thereby improving safety and increasing efficiency. Effective and efficient infection control in the dental office is essential for the safety of patients and to ensure that productivity does not suffer. Infection control programs all include the cleaning and sterilization of reusable dental instruments and devices. Care must be taken by the dental healthcare professional to ensure that all instruments are cleaned prior to sterilization, and that this is carried out in a safe manner to avoid injury and puncture wounds. Use of closed-system cassettes reduces the risk to dental healthcare professionals when executing infection control programs. When using ultrasonic cleaners, washers and sterilizers, it is important to always follow the manufacturer's instructions. It is also important to consult with the manufacturer of dental instruments and devices as needed to ensure complete sterilization and to avoid damage to these items. Assurance of sterility of instruments and devices can be obtained through the use of one of

several tests, and these tests must be performed regularly to ensure that the sterilizer is sterilizing all instruments and devices and that these are safe for use on patients.

STERILIZATION AND DISINFECTION OF DENTAL INSTRUMENTS:

CATEGORIES :

According to the Centers for Disease Control, dental instruments are classified into three categories depending on the risk of transmitting infection. The classifications of critical, semicritical and noncritical are based on the following criteria:

1) Critical instruments are those used to penetrate soft tissue or bone, or enter into or contact the bloodstream or other normally sterile tissue. They should be sterilized after each use. Sterilization is achieved by steam under pressure (autoclaving), dry heat, or heat/chemical vapour. Critical instruments include forceps, scalpels, bone chisels, scalers and surgical burs.

2) Semi-critical instruments are those that do not penetrate soft tissues or bone but contact mucous membranes or non-intact skin, such as mirrors, reusable impression trays and amalgam condensers. These devices also should be sterilized after each use. In some cases, however, sterilization is not feasible and, therefore, high-level disinfection is appropriate. A high-level disinfectant is registered with the U.S. Environmental Protection Agency (EPA) as a "sterilant/disinfectant" and must be labeled as such.

3) Non-critical instruments are those that come into contact only with intact skin such as external components of x-ray heads, blood pressure cuffs and pulse oximeters. Such devices have a relatively low risk of transmitting infection; and, therefore, may be reprocessed between patients by intermediate-level or low-level disinfection. An intermediate-level disinfectant is EPA-registered as a "hospital disinfectant" and will be labeled for "tuberculocidal" activity (e.g., phenolics, iodophors, and chlorine-containing compounds). A low-level disinfectant is EPA-registered as a "hospital disinfectant" but is not labeled for "tuberculocidal" activity (e.g., quaternary ammonium compounds). The tuberculocidal claim is used as a benchmark to measure germicidal potency. Germicides labeled as "hospital disinfectant" without a tuberculocidal claim pass potency tests for activity against three representative microorganisms: *Pseudomonas aeruginosa*, *Staphylococcus aureus*, and *Salmonella choleraesuis*

- Sterilization:
- There are many stages for instrument sterilization. They are presoaking; cleaning; corrosion control and lubrication; packaging; sterilization; handling sterile instruments; storage.
- Distribution

Agents used in sterilization*Physical agents:*

1. Sunlight
2. Drying
3. Dryheat: flaming, incineration, hot air
4. Moist heat: pasteurization, boiling, steam under pressure, steam under normal pressure.
5. Filtration: candles asbestos pads, membranes
6. Radiation
7. Ultrasonic and sonic vibrations

Chemical agents:

1. Alcohols: ethyl, isopropyl, trichlorobutanol
2. Aldehydes: formaldehyde, glutaraldehyde
3. Dyes
4. Halogens
5. Phenols
6. Surface-active agents
7. Metallic salts

Gases: ethylene oxide, formaldehyde, beta propiolactone(20)

Transport of instruments to the sterilization area :

Most dental offices have a designated area for instrument reprocessing that is separate from the dental treatment room. This is ideal, since cleaning, sterilizing and storing instruments in the same room where the delivery of patient care is provided increases the risk of cross-contamination. The removal and disposal of single-use sharps such as needles, blades, orthodontic wires and glass must be done at the point of use, typically in the dental treatment room. Some instruments and materials are single-use only. Single-use items should be segregated in the operatory, and those that are sharp or otherwise pose a risk of injury must be discarded into a sharps container. Items without risk, such as a saliva ejector, can be thrown into the trash. Finally, the tray or cassette of reusable instruments is taken to the cleaning and sterilization area for processing.

To prevent accidental injury with the contaminated instruments, special handling should be used to transport the instruments to the cleaning and sterilization area.² The Centers for Disease Control and Prevention (CDC) states that, "Contaminated instruments should be handled carefully to prevent exposure to sharp instruments that can cause percutaneous injury. Instruments should be placed in an appropriate container at the point of use to prevent percutaneous injuries during transport to the instrument processing area." In addition, the Occupational Safety and Health Administration (OSHA) says, "The person handling the instruments through removal, cleaning, packaging and sterilization needs to use heavy-duty gloves to help prevent injury with sharp contaminated instruments." Although heavy-duty gloves (utility gloves) may feel more awkward than examination gloves, they provide extra protection while handling instruments during the cleaning, rinsing, drying, packaging and sorting procedures that take place during instrument reprocessing.(3)The fine tactile sensitivity needed during dental procedures is not necessary during instrument cleaning and sterilization; therefore,

heavy-duty gloves pose no problem in this regard. Additionally, nitrile utility gloves are available in a variety of sizes, allowing a more secure fit.

Cleaning:

Using mechanical means of instrument cleaning rather than hand scrubbing should minimize handling of instruments.(4)If procedures are used whereby hand scrubbing is necessary, heavy-duty (utility) gloves, mask, eyewear and gown should always be worn while cleaning.(5)Minimize the risk of puncture injury by scrubbing only one instrument at a time while holding it low in the sink. Use of a system utilizing locked cassettes eliminates the need to sort, handle and hand scrub individual instruments - reducing the risk of infection from contaminated instruments - and results in savings of, on average, five minutes during instrument reprocessing, as well as fewer damaged instruments, since the instruments are locked in position during reprocessing. As with any standardized procedure, a standardized instrument reprocessing protocol also results in easy staff training and cross-training.

In general, three classifications of mechanical cleaning devices are available for the dental office. They are the ultrasonic cleaner, instrument washer and instrument washer/disinfector.

Ultrasonic cleaning devices:

An ultrasonic cleaner uses sound waves, that are outside the human hearing range to form oscillating bubbles, a process called cavitation. These bubbles act on debris to remove it from the instruments. Some manufacturers also use intermittent or sweeping sound waves to help improve the device's cleaning ability and to decrease the potential for hot spots in the ultrasonic bath. Specialized detergent formulations are available for the solutions in ultrasonic machines. When selecting a cleaning agent to use in the ultrasonic cleaner, always consider the effect on materials and instruments. Household products are inappropriate because they cause pitting, corrosion, rust or other damage to instruments, and potentially to the ultrasonic chamber. Therefore, it is best to follow the manufacturer's instructions, thereby choosing a solution that is compatible with the unit and the instruments. The procedure for cleaning the instruments in the ultrasonic cleaner is as follows(5)

- Suspend instruments in the ultrasonic bath using a rack or basket fitted to the unit.
- Do not lay instruments directly on the bottom of the ultrasonic cleaner, as this can interfere with cleaning and cause damage to instruments and the ultrasonic machine.
- Avoid overloading the ultrasonic device, since that could inhibit its cleaning ability.

It is important to follow the manufacturer's instructions for the ultrasonic cleaning cycle.

In general, the timer is activated for three to six minutes for loose instruments and ten to twenty minutes for instrument cassettes, and the timing is adjusted as necessary. While the ultrasonic device is running, the lid or cover should be kept

on to reduce the release of aerosol and spatter into the area from the ultrasonic cleaner. Routinely replacing the cleaning solution in the ultrasonic machine is important, and is necessary at least once a day, more often with heavy usage.

Instrument washers:

Instrument washers use high-velocity hot water and a detergent to clean instruments. Widely used for decades in hospitals and large facilities as part of the central sterilization process, these devices have recently become available for the dental office. These devices require personnel to either place instruments in a basket or to use instrument cassettes during the cleaning and drying cycles. Instrument washers for dental offices come in two different designs. One is a counter-top model. This type does not require professional installation. The other type is built-in and resembles a kitchen dishwasher. It functions much the same as the counter-top model, but it has a larger capacity and requires professional installation. Some models have the ability to dry the instruments after washing, some do not.(5)

Instrument washers/thermal disinfectors:

These devices may look like the instrument washers described above; however, there is one important difference. The high temperature of the water and chemical additives in these devices cleans and disinfects the instruments. The significance of this lies in how personnel can handle the instruments after the process. Upon removal from a thermal disinfectant, instruments can be more safely handled, and if the dental healthcare professional were to sustain a puncture injury, it would not require the follow-up that a contaminated exposure requires.

All instrument washers and thermal disinfectors use either a detergent or a water-softening agent. It is possible for the pH of some of these chemicals to be incompatible with certain metals in dental instruments. For specific recommendations, the manufacturer of the dental instruments and the manufacturer of the instrument washer should be consulted.

Instrument washers and thermal disinfectors are approved medical devices that have been rigorously tested to meet Food and Drug Administration (FDA) requirements for safety and efficacy of medical devices; household dishwashers are not appropriate for use in a dental office.

Instrument examination and care

Cleaning instruments, provides a good opportunity to examine, replace or remove damaged instruments; lubricate items such as hand pieces(6) and otherwise prepare instruments for sterilization. Instruments must be dry before packaging - if drying was not part of the cleaning process, time must be taken to dry the instruments completely. High-quality metal dental cassettes specially designed to withstand high temperatures are preferred for use with steam and chemical vapor sterilizers. Most sterilizers on the market today offer a cassette rack, which helps to prevent over-loading in the sterilizer, thereby reducing the risk of ineffective sterilization and ultimately of infection and cross-infection.

Packaging:

Packaging used for instruments and cassettes prior to sterilization includes wrap, paper pouches, plastic pouches, combination paper/plastic pouches and nylon tubing. Sterilization packaging is specifically designed to allow penetration of heat, steam or vapour and then to seal the sterilized instruments inside the package for sterile storage. After sterilization, instruments should remain in packages until use. Different materials are appropriate for different types of sterilizers.(7,8)Unless otherwise specified, all packaging is single use only. Using tape to reseal previously used packaging material may inhibit its ability to continue to function as intended by the manufacturer.

Sterilization:

Parameters such as time, pressure and temperature vary according to the type of sterilizer, materials being sterilized and individual models within sterilizer brands. The first step in determining the settings for the sterilizer is to refer to the manufacturer's instructions. Sterilizers are medical devices, requiring clearance by the Food and Drug Administration before manufacturers may offer them for sale. The FDA requires rigorous testing to ensure an adequate margin of safety in each cycle type described in the instructions. Failing to follow the instructions of the manufacturer is ill advised, since it may result in inadequate sterilization of the instruments or devices in the sterilizer. It is never appropriate to use a household device, such as a toaster oven, for sterilization of dental instruments, devices, or equipment.

Steam autoclave:

Steam autoclaves are the most commonly used type of heat sterilizer in dental practices. Two types of processes employ steam under pressure. The difference between the two is the manner in which the machine evacuates the air from the sterilization chamber and then introduces the steam.

Gravity displacement sterilizers rely on the forces of gravity to force air out of the chamber through air escape vents. The steam entering the chamber from the water reservoir displaces the air as it leaves the chamber. The combination of pressurization of the chamber, steam and a high temperature for a prolonged period has the ability to kill virtually all microorganisms. This is the most common type of autoclave found in dental offices in the United States. A typical cycle for wrapped instruments includes heat-up and pressurization time, followed by a 15-to-30-minute cycle during which sterilization is taking place (121°C at 15 psi). The sterilization cycle time decreases as the temperature is increased. It is important to use cycle times and temperatures described in the owner's manual, and never to interrupt the sterilization cycle to remove or add items, or for any other reason. Interruption of the cycle will result in instruments that are not sterile and therefore not safe for use on patients. After the sterilization cycle, the sterilizer must depressurize and the packs remain in the sterilizer for drying. The drying phase may take anywhere from 20-45 minutes. The unit must only be opened after completion of the drying cycle. Upon removal from the

sterilizer, sterile packs must be stored in a clean, dry area. Packs that become wet, torn, contaminated, or otherwise compromised require resterilization(9).

Pre vacuum autoclaves (also called Class B or Type B sterilizers) use a variety of technologies to remove air from the chamber before the steam enters, thus creating a vacuum. Most use a pulse vacuum to ensure elimination of air from the chamber. This is generally a more efficient means of pressurizing the chamber; therefore, the operator may notice some minor time saving in the start-up of the pre vacuum sterilizers. Most pre vacuum sterilizers use a temperature of 132°C-135°C for 3-10 minutes to achieve sterilization. This higher temperature may be unacceptable for some items, such as Teflon-coated instruments. Total time for pressurization, sterilization, venting and drying is generally considerably shorter than that for gravity sterilizers - about 45 minutes.

Advantages of Autoclaves :

1. Autoclaving is the most rapid and effective method for sterilizing cloth surgical packs and towel packs.
2. Is dependable and economical
3. Sterilization is verifiable.

Disadvantages of Autoclaves :

1. Items sensitive to the elevated temperature cannot be autoclaved.
2. Autoclaving tends to rust carbon steel instruments and burs.
3. Instruments must be air dried at completion of cycle

Dry-heat sterilization (convection and static air):

Dry-heat sterilization employs high temperatures for extended periods to achieve sterilization of instruments. The method of heat circulation in dry-heat sterilizers is usually convection, which helps to ensure that the heat circulates throughout the sterilization chamber during the process. Mechanical convection is more effective; the sterilizer contains a fan or blower that continually circulates the heated air to maintain a uniform temperature throughout the chamber. Most commercially available dry-heat sterilizers on the market today are of this type.

The higher temperature of a dry-heat sterilizer means that paper will scorch and plastic will melt. (10)Specialized packaging material is available for dry-heat sterilizers. Most hand pieces will not tolerate the higher temperatures of a dry-heat sterilizer. Mechanically driven hand pieces that contain turbines and bearings are susceptible to damage at higher temperatures. The manufacturer's instructions should be checked for compatibility of instruments, devices, and materials with the unit and the hand-piece manufacturer's instructions should be followed for preparation of the hand- piece prior to sterilization and for sterilization itself.(10)

Unsaturated chemical vapor sterilization:

Unsaturated chemical vapor sterilization relies upon the use of a proprietary chemical that contains formaldehyde, alcohol and other inert ingredients, instead of water, to produce a vapor to promote the sterilization. Use of this

proprietary chemical also results in the vapor having less humidity and therefore being less corrosive to sensitive instruments than if water were used.

Sterility assurance:

All the efforts that go into the preparation of instruments are futile if the sterilization process itself is not successful. There is no way of seeing that instruments are sterile by simply observing the sterilizers and packs, even though a chemical or mechanical indicator may have changed. An indicator such as autoclave tape may change colour when exposed to heat, but there is a possibility that the heat was not present for the proper length of time or that there was inadequate pressure. Indicators that go on the outside of the packs are useful for identifying processed and unprocessed packs. Failure of sterilization can occur due to mechanical malfunction of the sterilizer or due to operator error. There are several methods to provide assurance of sterility.(10)

Operator error:

It is common to rely upon the automated functions of the sterilizer to tell the DHCP if there is a problem with the sterilization process. Most sterilizers have a system to notify the operator of mechanical malfunction, but sterilizers cannot notify the operator whether the contents of the instrument packs or cassettes are sterile or not. Operator error in loading the sterilizer could result in failure to sterilize all the packs in spite of the proper time, temperature and/or pressure. It is important to avoid overloading the sterilizer or loading packs(10) and cassettes on top of one another; use of a cassette system helps to reduce operator error due to overloading. The heat and/or steam must be able to circulate throughout the chamber and between the packs or cassettes for successful sterilization.

Chemical indicators:

Chemical indicators indicate the presence of certain conditions during the sterilization cycle, such as the presence of heat and steam.(10)There are five classifications of indicators recognized by the FDA, and it is important to note that it is now recommended that all packs or cassettes include internal and external indicators.

Class 1 - Process Indicators: These are placed on the outside of packs and are useful in determining which packs have been properly processed versus those that have not. Class 1 process indicators include autoclave tape and the colour change indicators embedded on the outside of sterilization packaging materials.

Class 2 - Bowie-Dick Indicators: These show the pass/fail in pre vacuum sterilizers. This test is conducted daily with the chamber empty, (10) during the first cycle of the sterilizer, and is available as a kit from commercial sterilization monitoring companies.

Class 3 - Temperature-Specific Indicator: These react to one of the critical parameters of sterilization and indicate exposure to a specific value such as temperature or psi.

Class 4 - Multi-parameter Indicators: These react to two or more of the critical parameters in the same manner as Class 3 indicators.

Class 5 - Integrating indicators: These are designed to react to all critical parameters of sterilization cycles. When used properly, integrating indicators may serve as the basis for the release of processed items, excluding implants. It is important to follow the manufacturer's specific instructions for use regarding a test challenge pack.

Biological monitoring:

The use of biological monitors (spore tests) is the most reliable method to validate that the sterilizer is functioning and that the sterilization of instruments is effective. These monitors consist of paper strips or vials impregnated with bacterial spores that are specifically resistant to the sterilization process. New spore tests have been developed that enable completion of biological monitoring in-office and yield results in as little as 24 hours. These tests allow quick remediation and validate proper infection control procedures without a long lag time during which the sterilization procedure may have become ineffective but is not known. It is recommended that biological monitoring be conducted at least weekly (11) and with every load that includes an implantable device.

Clinical sterilization:

Infection control:

- Microorganisms are ubiquitous.
- Since pathogenic microorganisms cause contamination, infection and decay, it becomes necessary to remove or destroy them from materials and areas.

This is the objective of infection control and sterilization(13)

DEFINITIONS:

- **INFECTION CONTROL** – Also called “exposure control plan” by OSHA is a required office program that is designed to protect personnel against risks of exposure to infection.
- **STERILIZATION:** Use of a physical or chemical procedure to destroy all microorganisms including substantial numbers of resistant bacterial spores. Sterilization means the destruction of all life forms. (Ronald B Luftig)(13)
Sterilization is the process of killing or removing all viable organisms. (MIMS – PLAYFAIR)
- **STERILE:** Free from all living microorganisms; usually described as a probability (e.g., the probability of a surviving microorganism being 1 in 1 million).
- **DISINFECTION:** Destruction of pathogenic and other kinds of microorganisms by physical or chemical means. Disinfection is less lethal than sterilization, because it destroys the majority of recognized pathogenic microorganisms, but not necessarily all microbial forms (e.g., bacterial spores).

Disinfection is a process of removing or killing most, but not all, viable organisms. (MIMS-PLAYFAIR)

Disinfection refers to the destruction of pathogenic organisms. (Ronald B Luftig)

- **DISINFECTANT:** A chemical agent used on inanimate objects to destroy virtually all recognized pathogenic microorganisms, but not necessarily all microbial forms (15)
- **ASEPSIS:** prevention of microbial contamination of living tissues or sterile materials by excluding, removing or killing microorganisms.

Infection control:

Preprocedural mouth rinse:

Phenolic related essential oils; Bis-biguanides; Quaternary ammonium compounds; Halogens; Oxygenating agent; A commercial mouthrinse containing 0.05 percent CPC when used as a preprocedural mouthrinse was equally effective as CHX in reducing the levels of spatter bacteria generated during ultrasonic scaling(12).

Hand sterilization:

For routine dental examination procedures, hand washing is achieved by using either a plain or antimicrobial soap and water. The purpose of surgical hand antisepsis is to eliminate transient flora and reduce resident flora to prevent introduction of organisms in the operative wound, if gloves become punctured or torn. At the beginning of a routine treatment period, watches and jewelry must be removed and hands must be washed with a suitable cleanser. Hands must be lathered for at least 10 seconds, rubbing all surfaces and rinsed. Clean brushes can be used to scrub under and around the nails. Must be repeated at least once to remove all soil.

Hand cleansers:

- **Chlorhexidine based** – these contain 2- 4% chlorhexidine gluconate with 4% isopropyl alcohol in a detergent solution with a pH of 5.0 to 6.5. They have broader activity for special cleansing(e.g: for surgery, glove leaks, or when clinician experiences injury). But it can be hazardous to eyes.
- **Povidone iodone** – contain 7.5-10% povidone iodine, used as a surgical hand scrub.
- **Parachlorometaxenol(PCMX)** – they are bactericidal and fungicidal at 2% concentration. Non irritating and recommended for routine use.
- **Alcohol hand rubs-** ethyl alcohol and isopropyl alcohol are widely used at 70% concentration. They are rapidly germicidal when applied to the skin.(15)

Personal barrier protection:

- Personal protective equipment (PPE), or barrier precautions, are a major component of Standard precautions.
- PPE is essential to protect the skin and the mucous membranes of personnel from exposure to infectious or potentially infectious materials.
- The various barriers are gloves, masks, protective eye wear, surgical head cap & overgarments (15)

n95 particulate respirator:

- National Institute for Occupational Safety and Health (NIOSH) introduced a rating system which identifies the abilities of respirators to remove the most difficult particles to filter, referred to as the most penetrating particle size (MPPS), which is 0.3µm in size.
- The “N” means “Not resistant to oil”.
- N95: captures at least 95% of particles at MPPS.
- N99: captures 99% of particles at MPPS.
- N100: captures 99.97% of particles (13)

Eye wear**CAUSES OF EYE DAMAGE:**

1. Aerosols and spatter may transmit infection
2. Sharp debris projected from mouth while using air turbine handpiece, ultrasonic scaler may cause eye injury.
3. Injuries to eyes of patients caused by sharp instruments especially in supine position (13)

DISINFECTION : it's a vital part of sterilization. Disinfection is always at least a two-step procedure:

The initial step involves vigorous scrubbing of the surfaces to be disinfected and wiping them clean.(18)

The second step involves wetting the surface with a disinfectant and leaving it wet for the time prescribed by the manufacturer

The ideal disinfectant has the following properties(19)

1. Broad spectrum of activity
2. Acts rapidly
3. Non corrosive
4. Environment friendly
5. Is free of volatile organic compounds
6. Nontoxic & nonstaining
7. *High-level disinfection*: Disinfection process that inactivates vegetative bacteria, mycobacteria, fungi, and viruses but not necessarily high numbers of bacterial spores. (17)
8. *Intermediate-level disinfection*: Disinfection process that inactivates vegetative bacteria, the majority of fungi, mycobacteria, and the majority of viruses (particularly enveloped viruses) but not bacterial spores.
9. *Low-level disinfectant*: Liquid chemical germicide. OSHA requires low-level hospital disinfectants also to have a label claim for potency against HIV and HBV.
10. Gigasept which contains succindialdehyde and dimethoxytetrahydrofuran are used for disinfection of plastic and rubber materials eg: dental chair (17,18,19)

Cleaning and disinfection strategies for blood spills :

Strategies for decontaminating spills of blood and other body fluids differ by setting and volume of the spill. The person assigned to clean the spill should wear gloves and other PPE as needed. Visible organic material should be removed with absorbent material (e.g., disposable paper towels discarded in a leak-proof, appropriately labeled container). Nonporous surfaces should be cleaned and then decontaminated with either an hospital disinfectant effective against HBV and HIV or an disinfectant with a

tuberculocidal claim (i.e., intermediate-level disinfectant). However, if such products are unavailable, a 1:100 dilution of sodium hypochlorite (e.g., approximately ¼ cup of 5.25% household chlorine bleach to 1 gallon of water) is an inexpensive and effective disinfecting agent.(20)

Principles and procedures for handling and cleaning instruments after treatment:

The safest and most efficient instrument cleaning procedures involve ultrasonic cleaning of used instruments kept in a perforated basket or cassette throughout the cleaning procedure. Used instruments are commonly placed in an anti microbial solution as this softens and loosens debris. Next, move the or basket of instruments into an ultrasonic cleaning device, rinse them, and then carefully inspect the instruments for debris. Dip instruments likely to rust into a rust inhibitor solution. Drain & dry instruments with absorbent towel.(17)

Ethylene oxide sterilization (ETO): The ethylene oxide sterilization**Advantages:**

1. Operates effectively at low temperatures
2. Gas is extremely penetrative
3. Can be used for sensitive equipment like hand-pieces.
4. Sterilization is verifiable

Disadvantages:

1. Potentially mutagenic and carcinogenic.
2. Requires aeration chamber ,cycle time lasts hours
3. Usually only hospital based

Gamma radiation :The Nature of Gamma Radiation A form of pure energy that is generally characterized by its deep penetration and low dose rates, Gamma Radiation effectively kills microorganisms throughout.

Benefits of Gamma Radiation include:

1. precise dosing
2. rapid processing
3. uniform dose distribution
4. system flexibility
5. dosimetric release—the immediate availability of product after processing.

Penetrating Sterilization: Even with High-Density Products Gamma Radiation is a penetrating sterilant.

Substantial Decrease in Organism Survival: Gamma Radiation kills microorganisms by attacking the DNA molecule

Uv radiation:

The wavelength of UV radiation ranges from 328 nm to 210 nm (3280 Å to 2100 Å). Its maximum bactericidal effect occurs at 240–280 nm. Inactivation of microorganisms results from destruction of nucleic acid through induction of thymine dimers. UV radiation has been employed in the disinfection of drinking water , air, titanium implants, and contact lenses. The application of UV radiation in the health-care environment (i.e., operating rooms, isolation rooms, and biologic safety cabinets) is limited to destruction of airborne organisms or inactivation of microorganisms on surfaces(20)

Flash sterilization:

Flash" steam sterilization was originally defined by Underwood and Perkins as sterilization of an unwrapped object at 132°C for 3 minutes at 27-28 lbs. of pressure in a gravity displacement sterilizer. Currently, the time required for flash sterilization depends on the type of sterilizer and the type of item (i.e., porous vs non-porous items). Flash sterilization is considered acceptable for processing cleaned patient-care items that cannot be packaged, sterilized, and stored before use. It also is used when there is insufficient time to sterilize an item by the preferred package method.(22)

Oxygen plasma sterilization :

Pure oxygen reactive ion etching type of plasmas were applied to inactivate a biologic indicator, the *Bacillus stearothermophilus*, to confirm the efficiency of this process. The sterilization processes took a short time. In situ analysis of the micro-organisms' inactivating time was possible using emission spectrophotometry. The increase in the intensity of the 777.5 nm oxygen line shows the end of the oxidation of the biologic materials. Files sterilized by autoclave and lasers were completely sterile. Those sterilized by glass bead were 90% sterile and those with glutaraldehyde were 80% sterile.(23)

Ultrasonic scalars:

Soak inserts in a container containing 70% isopropyl alcohol for removal of organic debris; Rinse cleaned inserts thoroughly in warm water to remove all chemicals. As a final rinse, replace the insert into the scaler handpiece and operate the scaler for 10 seconds at the maximum water flow setting to flush out any retained chemicals; Dry inserts completely with air syringe; Package in proper wrap, bags, pouches, trays, or cassettes; Add spore tests and chemical indicators; Ethylene Oxide is the preferred method of choice; Dry heat and chemical vapor methods of sterilization are considered ineffective methods with risk of damage to materials (25).

Clinical waste disposal:

Red indicates the anatomical waste; yellow indicates waste which requires disposal by incineration only; black indicates domestic waste minimum treatment/disposal required is landfill, municipal incineration; Blue is for medicinal waste for incineration; White is for amalgam waste for recovery(24)

Handpiece asepsis:

Oral fluid contamination problems of rotary equipment and especially the high-speed hand piece involve: contamination of hand-piece external surfaces and crevices; turbine chamber contamination that enters the mouth; water spray retraction and aspiration of oral fluids into the water lines of older dental units; growth of environmental aquatic bacteria in water lines; exposure of personnel to spatter and aerosols generated by intraoral use of rotary equipment(25).

CONCLUSION:

Pervasive increases in serious transmissible diseases over the last few decades have created global concern and impacted the treatment mode of all health care practitioners. Emphasis has now expanded to assuring and demonstrating to patients that they are well protected from risks of infectious disease. Infection control has helped to allay concerns of the health care personnel and instill confidence and in providing a safe environment for both patient and personnel.

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