Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
Phone: 0831-2477682 Fax: 0831-2479323
Email:mmnghids@gmail.com Website: www.mmdc.edu.in

STERILIZATION AND DISINFECTION

Cleaning is the physical removal of debris. It has two major effects. First, it reduces the number of micro-organisms present. Second, it removes organic matter, such as blood, tissue and other debris that may interfere with sterilization or disinfection. In some instances, cleaning is all that is necessary. Most often, however, it is the preliminary step before sterilization or disinfection. In these instances, it is referred to as pre-cleaning. Pre-cleaning is essential, because sterilization and disinfection procedures may not be effective if items have not been cleaned first.

Sterilization is the process that destroys all types and forms of micro- organisms including viruses, bacteria, fungi and bacterial endospores. Major methods of sterilization include the use of steam under pressure (steam autoclave), dry heat and unsaturated chemical vapor.

Disinfection is generally less lethal to pathogenic organisms than sterilization. Three levels of disinfection have been differentiated, depending on the type and form of micro-organisms destroyed.

The effectiveness of any disinfection procedure is influenced by several factors, including the type and number of micro-organisms present, the concentration and length of exposure to the disinfecting agent and the amount of organic matter or other debris present on the item being disinfected. For disinfecting agents to be effective, it is important that they are used according to the manufacturer's instructions.

I. When to sterilize:

The major factor determining whether an item must be sterilized, disinfected or simply cleaned is how it is used.

Items To Be Sterilized or Disinfected:-

- Instruments that penetrate oral soft tissue (the mucosa or skin) or bone must be sterilized after each use or discarded.
- These items are termed critical items and have the greatest risk of transmitting infection, for e.g. surgical instruments, periodontal knives and scaling instruments.
- Instruments that are not intended to penetrate oral soft tissues or bone (such as amalgam condensers, dental handpieces, mouth mirrors) but come in contact with mucous membranes or non-intact skin are termed semi critical items.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

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- These items pose a lower risk of disease transmission; however, because the majority of semi critical items in dentistry are heat tolerant, they also should be sterilized after each use.
- Reusable semi critical items not able to withstand heat (e.g. plastic impression trays, amalgam carriers, plastic instruments) should be processed with high-level disinfection.
- Non-critical patient-care items that come in contact with unbroken skin (e.g. radiograph head/cone, blood pressure cuff, facebow, pulse oximeter) in many cases need cleaning, or if visibly soiled then cleaning followed by disinfection is adequate (low level disinfection).
- If a non-critical item is spattered with blood or touched with a contaminated glove or hand, it should be cleaned and disinfected.
- Non-critical items can also be protected with barriers. If contamination does occur, just remove the barrier and throw it away. Disinfection is not necessary.

Items to Be Sterilized or Disinfected/Cleaned

- Critical Items
- Surgical instruments, periodontal knives and scaling instruments, forceps, burs etc.
- Sterilize
- Non- Critical Items
- Radiograph head/cone, blood pressure cuff, face bow, pulse oximeter etc.
- Cleaned and Disinfected
- Re-usable Semi-Critical Items
- Plastic impression trays, amalgam carriers, plastic instruments etc.
- Disinfected

Concerns about the transmission of infectious agents, such as the Hepatitis B virus (HBV) and the Human Immuno deficiency Virus (HIV) have caused us all to be more aware of the need to adequately sterilize and disinfect instruments and other equipments to protect ourselves and our patients.

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II. Sterilization Methods

A number of sterilization methods are available for heat tolerant dental instruments. These include use of steam under pressure (steam autoclave), dry heat or unsaturated chemical vapor. The duration of sterilization, temperatures and other operating parameters recommended by the equipment manufacturer should be used. Additionally, instructions for use of correct containers, wraps and chemical or biological indicators should always be followed.

Heat sterilization methods (steam autoclave, dry heat and unsaturated chemical vapor) are preferred for all equipment that can withstand high temperatures for several reasons:

- Effective.
- Relatively easy to use.
- Comparatively inexpensive.
- Readily monitored for effectiveness.

Liquid chemical disinfectants/sterilants should be used only when heat will damage an item.

Steam Sterilization

Among sterilization methods, steam sterilization is the most widely used for wrapped and unwrapped critical and semicritical items that are not sensitive to heat and moisture. When using an autoclave, the load must be placed so that steam can circulate freely around each item, because steam must be able to reach all instrument surfaces at a required temperature and pressure for a specified time in order to kill all microorganisms and achieve sterilization. Be sure to follow the autoclave manufacturer's operating instructions

The majority of tabletop sterilizers used in dental practice are gravity displacement sterilizers, although prevacuum sterilizers are becoming widely available. Prevacuum sterilizers are fitted with a pump to create a vacuum in the chamber and to ensure air removal from the sterilizing chamber before the chamber is pressurized with steam. Relative to gravity displacement, this procedure allows faster and more positive steam penetration throughout the entire load.

Autoclave

An autoclave is a self-locking machine that sterilizes with steam under pressure, achieved by the high temperature. Autoclaves are the universally accepted means for sterilization.

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& Research Centre, Belagavi-590010.

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It is generally accepted that an autoclave chamber must reach at least 121°C at 15 Psi for a minimum of 30 minutes to ensure adequate sterilization. Sterilization time may vary depending on the quantity and density of items in the autoclave chamber. Overloading must be avoided.

Instruments and materials for sterilizing in the autoclave are usually enclosed in the muslin wrappers as surgical packs. These packs should be porous to allow steam to penetrate and reach the instruments.

The autoclave is employed for the sterilization of the instruments, extraction forceps, surgical instruments, explorers etc. The sterilized instruments should remain wrapped until next used.

Testing of efficacy

Autoclave indicator tape and autoclave indicator bags change colour when the proper temperature has been reached. While the indicator tape quick-check should be conducted with every load, it must be supplemented periodically by use of a biological indicator (such as Bacillus spores) buried in the center of a load to confirm the sterilization.

Advantages of steam sterilization

1. Is quick and easy to use.
2. Allows loads to be packaged, making it easier to maintain items in a sterile state.
3. Penetrates fabric and paper wrappings.
4. Can be readily monitored for effectiveness.
5. Is economical and very reliable.

Disadvantages of steam heat sterilization

- May cause rust and corrosion (corrosion inhibitors such as sodium nitrite are available that may reduce this problem).
- May damage plastics.
- May blunt certain sharp items.

Dry Heat Sterilization

Dry heat is used to sterilize materials that might be damaged by moist heat (e.g. burs and certain orthodontic instruments). Although dry heat has the advantages of low operating costs and being non-corrosive, it is a prolonged process and the high temperatures required are not suitable for certain patient care items and devices with

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temperatures ranging from 300 degrees F (149 degrees C) and upward can be used for sterilization.

Dry heat sterilizers used in dentistry include static-air and forced-air types. The static-air type is commonly called an oven-type sterilizer. The forced-air type is also known as a rapid heat transfer sterilizer. Heated air is circulated through the chamber at a high velocity, permitting more rapid transfer of energy from the air to the instruments, thereby reducing the time needed for sterilization compared to the oven-type sterilizer.

Advantages of dry heat sterilization

1. Is very reliable.
2. Rust and corrosion are not a problem, provided that items are dry prior to sterilization. Is easy to use and requires little maintenance.
3. Can be readily monitored for effectiveness.

Disadvantages of dry heat sterilization

1. Usually requires longer processing times than do steam sterilization or unsaturated chemical vapour.
2. Damages some plastics.
3. Requires careful loading.
4. May char fabric.
5. High temperatures may prohibit use with some materials and may melt or destroy some metal or solder joints.

Unsaturated chemical vapour sterilization

Unsaturated chemical vapour sterilization involves heating a chemical solution of primarily alcohol with formaldehyde in a pressurized chamber. This method of sterilization is ideally suited to carbon steel instruments (e.g. dental burs) because the low level of water present during the cycle results in less corrosion than might be expected with steam sterilization. Instruments must be dry before sterilization. Follow the manufacturer's instructions.

Advantages of chemical vapour sterilization

1. Is relatively quick.
2. Does not rust or corrode metal items. Is very reliable.
3. Can be used with packaged items (paper packaging only).
4. Can be monitored for effectiveness.

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Disadvantages of chemical vapour sterilization

1. Requires good ventilation owing to fumes. Won't penetrate fabric- wrapped packs. Damages some plastics.
2. Requires replacement of special solution, increasing cost.
3. Requires hazardous waste disposal of the sterilizing solution.

Sterilization of Unwrapped Instruments

An unwrapped sterilization cycle (sometimes called flash-sterilization) is a method of sterilizing patient care items for immediate use. Critical and semi- critical items that have been sterilized unwrapped should be transferred immediately, using aseptic technique for the ultimate use. The unwrapped sterilization cycle in tabletop sterilizers is usually preprogrammed by the manufacturer to a specific time and temperature setting.

Thorough cleaning and drying of instruments precedes the unwrapped cycle. Mechanical monitors are checked and chemical indicators are used for each cycle. Care is taken to avoid thermal injury to dental workers and patients.

Items are handled and transported aseptically to the point of use to maintain sterility. As implantable devices should be quarantined after sterilization until the results of biological monitoring are known, unwrapped or flash sterilization of implantable devices is not recommended.

Other Methods of Sterilization

Liquid chemical germicides: Heat-sensitive critical and semicritical instruments and devices can be sterilized by immersing them in liquid chemical germicides. However, items sterilized in this manner can require approximately 12 hours of complete immersion.

Additionally items sterilized in this manner must be rinsed with sterile water to remove any toxic or irritating residues, handled using sterile gloves and dried with sterile towels, delivered to the point of use in an aseptic manner and then used immediately.

Because of these limitations, they are almost never used to sterilize instruments. Rather, these chemicals are more often used for high-level disinfection of heat-sensitive semicritical instruments and devices. Shorter immersion times (12-90 minutes) make high-level disinfection more practical than sterilization; however, instruments and devices disinfected in this manner must still be handled as if sterile (e.g. rinsed with sterile water, dried with sterile towels, etc.) and used immediately.

Chemical sterilants (e.g. glutaraldehyde, peracetic acid, hydrogen peroxide) are powerful, sporicidal chemicals and are highly toxic. Instruments can be sterilized by

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Principal
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placing them in a 2% solution of glutaraldehyde for 6-10 hours. The chemical sterilants must only be used according to manufacturer's instructions and for those applications indicated on their label. Misapplications include use as an environmental surface disinfectant or instrument holding solution.

Alcohols are effective as skin antiseptics. Usually a 50% to 80% ethyl alcohol solution is recommended.

In general, use of heat-sensitive semi- critical items that must be processed with liquid chemical germicides is discouraged; heat-tolerant or disposable alternatives are available for the majority of such items.

Ethylene oxide gas (ETG): Low temperature sterilization with ETG has been extensively used in larger health care facilities. However, extended sterilization times of 10-48 hours and potential hazards to patients and the dental team that require stringent health and safety requirements make this method impractical for the private-practice setting.

Bead sterilizers: Historically, bead sterilizers have been used in dentistry to sterilize small metallic instruments (e.g. endodontic files). This method employs a heat transfer device. The media used are glass beads or salt and the temperature achieved is 220°C.

The method employs submersion of small instruments such as endodontic files and burs into the beads; they are sterilized in 10 seconds provided they are clean.

III. Patient care items:

The intended use of the patient-care item should determine the recommended level of disinfection. Dental practices should follow the product manufacturer's directions regarding concentrations and exposure time for disinfectant activity relative to the surface to be disinfected.

Transporting and Processing Contaminated Critical and Semicritical Patient-Care Items

- Dental practitioners can be exposed to micro-organisms on contaminated instruments and devices through percutaneous injury, contact with non-intact skin on the hands or contact with mucous membranes of the eyes, nose or mouth.
- Contaminated instruments should be handled carefully to prevent exposure to sharp instruments that can cause a percutaneous injury.

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- Sterilization is a complex process requiring specialized equipment, adequate space, qualified dental practitioner who are provided with ongoing training and regular monitoring for quality assurance.
- Correct cleaning, packaging, sterilizer loading procedures, sterilization methods or high-level disinfection methods should be followed to ensure that an instrument is adequately processed and safe for reuse on patients.

Instrument Processing Area

- Dental practitioners should process all instruments in a designated central processing area to ensure quality control and safety. The central processing area should be divided into sections for

    1. Receiving, cleaning and decontamination.
    2. Preparation and packaging.
    3. Sterilization.
    4. Storage.

- Ideally, walls or partitions should separate the sections to control traffic flow and contain contaminants during processing.
- When physical separation of these sections cannot be achieved, adequate spatial separation is necessary to prevent contamination of clean areas.
- Space should be adequate for the anticipated volume of work and storage of items.

Receiving, Cleaning and Decontamination

- Reusable instruments, supplies and equipment should be received, sorted, cleaned and decontaminated in one section of the processing area.
- Cleaning should precede all disinfection and sterilization processes; it will remove organic and inorganic contamination.
- Removal of debris and contamination is achieved either by scrubbing with a surfactant, detergent and water or by an automated process (e.g. ultrasonic cleaner or washer- disinfector) using chemical agents.
- If visible debris, whether inorganic or organic matter, is not removed, it will interfere with microbial inactivation and can compromise the disinfection or sterilization process.
- After cleaning, instruments should be rinsed with water to remove chemical or detergent residue.
- Splashing should be minimized during cleaning and rinsing.
- Before final disinfection or sterilization, instruments should be handled as though contaminated.

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- Considerations in selecting cleaning methods and equipment include :-
    1. Efficacy of the method, process and equipment.
    2. Compatibility with items to be cleaned.
    3. Occupational health and exposure risks.
- Use of automated cleaning equipment (e.g. ultrasonic cleaner or washer-disinfector) does not require presoaking or scrubbing of instruments and can increase productivity, improve cleaning effectiveness and decrease worker exposure to blood and body fluids.
- Using automated equipment can be safer and more efficient than manually cleaning contaminated instruments.
- If manual cleaning is not performed immediately, place instruments in a puncture-resistant container and soak them with disinfectant/detergent or an enzymatic cleaner to prevent drying of contaminated debris and makes cleaning easier and less time-consuming.
- It is recommended not to use liquid chemical sterilant/high-level disinfectant (e.g. glutaraldehyde) as a holding solution.
- Do not scrub sharp instruments.
- Wear puncture-resistant, heavy-duty utility gloves when handling or manually cleaning contaminated instruments and devices.
- Do not blindly reach into trays or containers holding sharp instruments. (E.g. sinks filled with soapy water in which sharp instruments have been soaked).
- Use strainer-type basket to hold instruments and forceps. Wear a mask, protective eyewear or face shield, gown or jacket to avoid splashing.

Preparation and Packaging

- In another section of the processing area, cleaned instruments and other dental supplies should be inspected, assembled into sets or trays and wrapped, packaged, or placed into container systems for sterilization.
- Hinged instruments should be processed open and unlocked.
- An internal chemical indicator should be placed in every package.
- In addition, an external chemical indicator (e.g. chemical indicator tape) should be used when the internal indicator cannot be seen from outside the package.
- Dental practices should refer to the manufacturer's instructions regarding use and correct placement of chemical indicators.
- Critical and semicritical instruments should be wrapped or placed in containers (e.g. cassettes or organizing trays) designed to maintain sterility.
- Packaging materials (e.g. wraps or container systems) allow penetration of the sterilization agent and maintain sterility of the processed item after sterilization.

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- Maintain sterility of instruments during transport and storage by using wrapped perforated instrument cassettes, peel pouches of plastic or paper and sterilization wraps (i.e. woven and non-woven).
- Packaging materials should be designed for the type of sterilization process being used.

Sterilization of Unwrapped Instruments

- Clean and dry instruments prior to the unwrapped sterilization cycle.
- Use mechanical and chemical (place an internal chemical indicator among the instruments or items to be sterilized) indicators for each unwrapped sterilization cycle.
- Allow unwrapped instruments to dry and cool in the sterilizer before they are handled to avoid contamination and thermal injury.
- Semi- critical instruments that will be used immediately or within a short time can be sterilized unwrapped on a tray or in a container system, provided that the instruments are handled aseptically during removal from the sterilizer and transported to the point of use.
- Critical instruments intended for immediate reuse can be sterilized unwrapped provided that the instruments are maintained sterile during removal from the sterilizer and transported to the point of use.
- Do not sterilize implantable devices unwrapped.
- Do not store critical instruments unwrapped.

Sterilization Monitoring

Use mechanical, chemical and biological monitors according to the manufacturer's instructions to ensure the effectiveness of the sterilization process.

Monitor each load with mechanical (e.g. time, temperature and pressure) and chemical indicators. Place a chemical indicator on the inside of each package. If the internal indicator is not visible from the outside, also place an exterior chemical indicator on the package. Do not use instrument packs if mechanical or chemical indicators indicate inadequate processing.

Monitor sterilizers at least weekly by using a biological indicator with a matching control (i.e. biological indicator and control from same lot number). Use a biological indicator for every sterilizer load that contains an implantable device. Verify results before using the implantable device, whenever possible.

The following are recommended in the case of a positive spore test:

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

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- Remove the sterilizer from service and review sterilization procedures (e.g. work practices and use of mechanical and chemical indicators) to determine whether operator error could be responsible;
- Retest the sterilizer by using biological, mechanical and chemical indicators after correcting any identified procedural problems and
- If the repeat spore test is negative and mechanical and chemical indicators are within normal limits, put the sterilizer back in service.

The following are recommended if the repeat spore test is positive:

- Do not use the sterilizer until it has been inspected or repaired or the exact reason for the positive test has been determined,
- Recall, to the extent possible and reprocess all items processed since the last negative spore test and
- Frequently clean all working areas contaminated with latex powder or dust.
- Have emergency treatment kits with latex-free products available at all times.
- Before placing the sterilizer back in service, rechallenge the sterilizer with biological indicator tests in three consecutive empty chamber sterilization cycles after the cause of the sterilizer failure has been determined and corrected.

Maintain sterilization records (i.e. mechanical, chemical and biological).

IV. Sterilization process:

- Presoaking : A presoaking solution (phenolic compounds) prevents drying of debris, helps to dissolve or soften organic debris and sometimes helps in microbial killing.

- Cleaning: Cleaning can be done either by hand, scrubbing or with the use of ultrasonic devices.
- Corrosion control and lubrication: Instruments must be dried prior to sterilization to decrease chances of corrosion. The non-stainless steel instruments should be coated with a rust inhibitor.
- Packaging: The instruments can be packed individually or in small groups and distributed on sterile or disposable disinfected trays for use at chair side. For wrapping, thin paper bags should be avoided as they will permit sharp and pointed instruments like sickle scalers to protrude and cause injury during handling. See- through polyfilm bags or pouches facilitate instrument identification.
- Sterilization: Autoclaving is the most accepted method of sterilization of surgical instruments as it eliminates bacteria, viruses, fungi and spores. It works

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

on the principle of steam under pressure of 15 lbs at 121°C for 20 minutes, or 30 lbs at 134°C for 3 minutes. It has excellent penetration, facilitating exposure of all instrument surfaces to the steam. It has a relatively short cycle time and can sterilize water-based liquids. Dry heat ovens or the unsaturated chemical vapour sterilizers are the other means of sterilization. Ultraviolet light may kill micro-organisms that are directly exposed to the light; however, the light may not reach all the surface of an instrument. A temperature of 160°C-170°C maintained for 1 hour is capable of sterilization. This method is acceptable for cloth goods and paper items.

- Handling sterile instruments: Post sterilization procedures involve drying, cooling, storage and distribution. As far as possible the sterile packages or trays should not be handled, till required for use, to reduce recontamination.
- Storage: Sterile packs and trays should be kept in dry, low dust, low traffic areas away from sinks and sewer of water pipes, at least a few inches above the floor.
- Distribution: Sterilized packs containing functional sets or individual items can be placed on sterile, disposable trays for use at chair side. The instruments which are disinfected in a liquid germicide should be handled aseptically with sterile tongs, kept on sterile trays and then covered. Placing unwrapped or wrapped instruments in drawers for direct use at chair side is not recommended.

V. Storage of sterilized items:

- The storage area should contain enclosed storage for sterile items and disposable (single-use) items.
- Storage practices for wrapped sterilized instruments can be either date or event-related.
- Packages containing sterile supplies should be inspected before use to verify barrier integrity and dryness.
- Ideally a product should remain sterile indefinitely, unless an event causes it to become contaminated (e.g. torn or wet packaging).
- Even for event-related packaging, minimally, the date of sterilization should be placed on the package and if multiple sterilizers are used in the facility, the sterilizer used should be indicated on the outside of the packaging material to facilitate the retrieval of processed items in the event of a sterilization failure.
- If packaging is compromised, the instruments should be recleaned, packaged in new wrap and sterilized again.
- Clean supplies and instruments should be stored in closed or covered cabinets, if possible.

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- Dental supplies and instruments should not be stored under sinks or in other locations where they might become wet.

VI. Surface disinfection:

Surface contamination can occur during patient care. Certain surfaces especially the ones touched regularly during patient care (e.g. light handles, unit switches and drawer knobs can serve as reservoirs of microbial contamination). These surfaces can be divided into clinical contact surfaces and housekeeping surfaces.

Clinical Contact Surface

Clinical contact surfaces can be directly contaminated from patient materials either by direct spray or spatter generated during dental procedures or by contact with dental professionals' gloved hands. These surfaces can subsequently contaminate other instruments, devices, hands or gloves.

- Examples of such surfaces include:-
    - light handles,
    - switches,
    - dental radiograph equipment,
    - dental chairside computers,
    - reusable containers of dental materials,
    - drawer handles,
    - faucet handles,
    - countertops,
    - pens,
    - telephones and
    - Doorknobs.
- Barrier protection of surfaces and equipment can prevent contamination of surfaces which are difficult to clean. Barriers includes using clear plastic wrap, bags, sheets, tubing and plastic-backed paper or other materials impervious to moisture.
- These coverings can become contaminated. They should be removed and discarded between patients, while DHCP are still gloved. After removing the barrier, examine the surface to make sure it did not become soiled. The surface needs to be cleaned and disinfected only if contamination is evident. Otherwise, after removing gloves and performing hand hygiene, DHCP should place clean barriers on these surfaces before the next patient.

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- If barriers are not used, surfaces should be cleaned and disinfected between patients by using a disinfectant with an HIV, HBV claim (i.e. low- level disinfectant) or a tuberculocidal claim (i.e. intermediate-level disinfectant). Intermediate-level disinfectant should be used when the surface is visibly contaminated with blood or OPIM.
- General cleaning and disinfection are recommended for surfaces, dental unit surfaces and countertops at the end of daily activities and these may have become contaminated since their last cleaning. To facilitate daily cleaning, treatment areas should be kept free of unnecessary equipment and supplies.
- Manufacturers of dental devices and equipment should provide information regarding material compatibility with liquid chemical germicides, whether equipment can be safely immersed for cleaning and how it should be decontaminated if servicing is required.
- Because of the risks associated with exposure to chemical disinfectants and contaminated surfaces, dental professionals who perform environmental cleaning and disinfection should wear gloves and other PPE to prevent occupational exposure to infectious agents and hazardous chemicals.
- Chemical and puncture-resistant utility gloves offer more protection than patient examination gloves when using hazardous chemicals.

VII. Housekeeping Surfaces

- Evidence does not support that housekeeping surfaces (e.g. floors, walls and sinks) pose a risk for disease transmission in dental health- care settings.
- These need to be cleaned only with a detergent and water or a disinfectant/detergent, depending on the nature of the surface and the type and degree of contamination.
- Schedules and methods vary according to the area (e.g. dental operatory, laboratory, bathrooms, or reception rooms), surface, amount and type of contamination.
- Floors should be cleaned regularly and spills should be cleaned up promptly. A disinfectant/detergent designed for general housekeeping purposes should be used in patient-care areas if uncertainty exists regarding the nature of the soil on the surface (e.g. blood or body fluid contamination versus routine dust or dirt).
- Unless contamination is reasonably anticipated or apparent, cleaning or disinfecting walls, window drapes and other vertical surfaces is unnecessary.
- However, when housekeeping surfaces are visibly contaminated by blood or OPIM, prompt removal and surface disinfection is essential.
- Part of the cleaning strategy is to minimize contamination of cleaning solutions and cleaning tools (e.g. mop heads or cleaning cloths).

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
Phone: 0831-2477682 Fax: 0831-2479323
Email:mmnghids@gmail.com Website: www.mmdc.edu.in

- Mops and cloths should be cleaned after use and allowed to dry before reuse or single-use, disposable mop heads and cloths should be used to avoid spreading contamination.

VIII. Disinfection of dental prosthesis and impressions:

To protect the laboratory personnel, impressions, gypsum casts, fixed and removable prosthesis, wax rims and bite registration records should be appropriately disinfected before sending them to the dental laboratory.

Dental prosthesis, impressions, orthodontic appliances and other prosthodontic materials (e.g. occlusal rims, temporary prosthesis, and bite registrations) should be thoroughly rinsed under gentle running water to remove blood, saliva or debris.

The disinfection can be done by a short-term immersion in 0.5% or 1% sodium hypochlorite. In addition, immersion in glutaraldehyde, povidone-iodine diluted in water or halogenated phenol has no apparent effect on the dimensional stability of rubber materials.

The best time to clean and disinfect the impressions, prosthesis or appliances is as soon as possible after removal from the patient's mouth, before drying of blood and saliva.

IX. Extracted teeth and biopsy specimen:

Handling of Biopsy specimens

- To protect persons handling and transporting biopsy specimens, each specimen must be placed in a sturdy, leak-proof container with a secure lid for transportation.
- Care should be taken when collecting the specimen to avoid contaminating the outside of the container.
- If the outside of the container becomes visibly contaminated, it should be cleaned and disinfected or placed in an impervious bag.
- The container must be labeled with the biohazard symbol during storage, transport, shipment and disposal.

Handling of Extracted Teeth

The extracted teeth should either be disposed or should be used for educational purpose.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
Phone: 0831-2477682 Fax: 0831-2479323
Email:mmnghids@gmail.com Website: www.mmdc.edu.in

- Extracted teeth are occasionally collected for use in educational training.
- These teeth should be cleaned of visible blood and gross debris and maintained in a hydrated state in a well- constructed closed container during transport.
- Because these teeth will be autoclaved before clinical exercises or study, use of the most economical storage solution (e.g. water or saline) might be practical.
- Liquid chemical germicides can also be used to disinfect both external surface and interior pulp tissue.
- Before being used in an educational setting, the teeth should be heat-sterilized to allow safe handling. Microbial growth can be eliminated by using an autoclave cycle for 40 minutes.
- Use of teeth that do not contain amalgam is preferred because they can be safely autoclaved.
- Extracted teeth containing amalgam restorations should not be heat-sterilized because of the potential health hazard from mercury vaporization and exposure.
- If extracted teeth containing amalgam restorations are to be used, immersion in 10% formalin solution for 2 weeks should be effective in disinfecting both the internal and external structures of the teeth.

X. Blood spills:

The majority of blood contamination in dentistry result from spatter during dental procedures using rotary or ultrasonic instrumentation. Although no evidence supports that HBV, HCV or HIV have been transmitted from a housekeeping surface, prompt removal and surface disinfection of an area contaminated by either blood or OPIM are appropriate infection-control practices.

- The person assigned to clean the spill should wear gloves and other PPE as needed.
- Visible organic material should be removed with an absorbent material (e.g. disposable paper towels discarded in a leak-proof, appropriately labeled container).
- Non-porous surfaces should be cleaned and then decontaminated with effective disinfectant.
- 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.

Carpeting and Cloth Furnishings

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
Phone: 0831-2477682 Fax: 0831-2479323
Email:mmnghids@gmail.com Website: www.mmdc.edu.in

Carpeting is more difficult to clean than non- porous hard- surface flooring and it cannot be reliably disinfected, especially after spills of blood and body substances. Cloth furnishings pose similar contamination risks in areas of direct patient care and places where contaminated materials are managed (e.g. dental operatory, laboratory or instrument processing areas). For these reasons, use of carpeted flooring and fabric-upholstered furnishings in these areas should be avoided.

Water unit:

Dental unit waterlines (i.e. narrow-bore plastic tubing that carries water to the high-speed handpieces, air/water syringe and ultrasonic scaler) may become colonized with micro-organisms, including bacteria, fungi and protozoa. These micro-organisms colonize and replicate on the interior surfaces of the waterline tubing and form a biofilm, which serves as a reservoir that can amplify the number of free-floating (i.e. planktonic) micro-organisms in water used for dental treatment and exhibit limited pathogenic potential for immunocompetent persons.

Patient material (e.g. oral microorganisms, blood and saliva) can enter the dental water system during patient treatment hence it is necessary to flush out the patient material that might have entered the turbine, air and waterlines.

Strategies to Improve Dental Unit Water Quality

- Dental waterlines should be flushed at the beginning of the clinic day to reduce the microbial load.
- However, this does not affect biofilm in the waterlines or reliably improve the quality of water used during dental treatment as the recommended value of <500 CFU/mL cannot be achieved by using this method.
- All incoming waterlines from the public water system inside the dental office (e.g. faucets, waterlines and dental equipment) should be flushed for 1 to 5 minutes.
- The length of time needed can vary with the type and length of the plumbing system of the office. After the incoming public water system lines are flushed, dental unit waterlines should be disinfected according to the manufacturer's instructions.
- Quality of water used can be improved by including self- contained water systems combined with chemical treatment, in-line micro filters and combinations of these treatments.
- Simply using source water containing <500 CFU/mL of bacteria (e.g. tap, distilled or sterile water) in a self- contained water system will not eliminate bacterial contamination in treatment water if biofilms in the water system are not controlled.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
Phone: 0831-2477682 Fax: 0831-2479323
Email:mmnghids@gmail.com Website: www.mmdc.edu.in

- Removal or inactivation of dental waterline biofilms requires use of chemical germicides.
- Physically flush out patient material that might have entered the turbine, air or waterlines by operating it to discharge water and air for a minimum of 20-30 seconds after each patient.
- Users should consult the owner's manual or contact the manufacturer to determine whether testing or maintenance of anti-retraction valves or other devices is required.

Maintenance and Monitoring of Dental Unit Water

- Dental practitioners should be trained regarding water quality, biofilm formation, water treatment methods and appropriate maintenance protocols for water delivery systems.
- Water treatment and monitoring products require strict adherence to maintenance protocols and noncompliance of treatment regimens is associated with persistence of microbial contamination in treatment systems.

XI. Handpieces and other devices:

Multiple semicritical dental devices that touch mucous membranes are attached to the air or waterlines of the dental unit. Among these devices are high and low-speed handpieces, prophylaxis angles, ultrasonic and sonic scaling tips, air abrasion devices and air and water syringe tips. These devices have the potential for retracting oral fluids into their internal compartments. Restricted physical access limits their cleaning. This indicates that retained patient material can be expelled intraorally during subsequent uses.

- Any dental device connected to the dental air/water system that enters the patient's mouth should be run to discharge water, air or a combination for a minimum of 20- 30 seconds after each patient.
- This procedure physically flushes outpatient material that might have entered the turbine, air and waterlines.
- Heat methods can sterilize dental handpieces and other intraoral devices attached to air or waterlines.
- Proper scrubbing with detergent, water and drying followed by wiping with a suitable chemical disinfectant is essential for those ultrasonic scalers, handpieces and air syringes that cannot be sterilized.
- For processing any dental device that can be removed from the dental unit air or waterlines, neither surface disinfection nor immersion in chemical germicides is an acceptable method.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
Karnataka, India
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Email:mmnghids@gmail.com Website: www.mmdc.edu.in

- Manufacturer's instructions for cleaning, lubrication and sterilization should be followed to ensure both the effectiveness of the process and the longevity of handpieces.
- Some components of dental instruments are permanently attached to dental unit waterlines and although they do not enter the patient's oral cavity, they are likely to become contaminated with oral fluids during treatment procedures.
- Components (e.g. handles or dental unit attachments of saliva ejectors, high-speed air evacuators and air/water syringes) should be covered with impervious barriers that can be changed after each use.
- If the item becomes visibly contaminated during use, dental practitioner should clean and disinfect with a disinfectant (intermediate- level) before use on the next patient.

Saliva Ejectors

- Backflow from low-volume saliva ejectors occurs when the pressure in the patient's mouth is less than that in the evacuator.
- Backflow in low-volume suction lines can occur and micro-organisms present in the lines retracted into the patient's mouth when a seal around the saliva ejector is created (e.g. by a patient closing lips around the tip of the ejector, creating a partial vacuum).
- This backflow can be a potential source of cross- contamination.
- Although no adverse health effects associated with the saliva ejector have been reported, practitioners should be aware that in certain situations, backflow can occur when using a saliva ejector.

XII. Single use or disposables:

- These must not be carried in uniform or clothing pockets.
- It is designed to be used on one patient and then discarded, not reprocessed for use on another patient (e.g. cleaned, disinfected, or sterilized).
- It is not heat-tolerant and cannot be reliably cleaned. Examples include syringe needles, prophylaxis cups and brushes and plastic orthodontic brackets.
- Certain items (e.g. prophylaxis angles, saliva ejectors, high- volume evacuator tips and air/water syringe tips) are commonly available in a disposable form.
- These items (e.g. cotton rolls, gauze and irrigating syringes) should be sterile at the time of oral surgical procedures.
- Because of the physical construction of certain devices (e.g. burs, endodontic files and broaches) cleaning can be difficult.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.

Maratha Mandal's
Nathajirao G Halgekar Institute of Dental Sciences & Research Centre,
R S No. 47A/2, Near KSRP Ground, Bauxite Road, Belagavi – 590 010
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- In addition, deterioration can occur on the cutting surfaces of some carbide/diamond burs and endodontic files during processing and after repeated processing cycles, leading to potential breakage during patient treatment.
- These factors, coupled with the knowledge that burs and endodontic instruments exhibit signs of wear during normal use, should be considered as single-use devices.

XIII. Checklist:

- Flush devices connected to dental unit air and water system for 20- 30 seconds between patients.
- Flush dental waterlines at the beginning and at the end of the day.
- Insert only sterile needles and syringes into multi-dose vials.
- Clean and disinfect blood spills immediately.
- Dispose of all single-use devices after use on patient.
- Use sterilized instruments for every patient.
- Decontaminate or properly contain and label extracted teeth.
- Properly dispose of extracted teeth containing amalgam.
- Heat sterilize extracted teeth before using them in educational settings.
- Disinfect dental prosthesis and impressions before sending to the laboratory.

Dr. Ramakant Nayak
Principal
M.M's. N.G. Halgekar Institute of Dental Sciences
& Research Centre, Belagavi-590010.