

REVIEW ARTICLE

Sterilization and Infection Control Measures in Dental Operatory

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ABSTRACT

Increase in the incidence of serious transmissible diseases over the last few decades has enhanced major concern and impacted the treatment mode of all health care practitioners. Nowadays, more emphasis is made to assure the patients that they are well protected from risks of infectious disease. Infection control is the most important phase of any dental therapy that has helped to allay concerns of the health care personnel and in providing a safe environment for both patient and personnel. This study reviews different sterilization and infection control protocols in a dental operatory.

Keywords: Autoclave, Indicators, Infection control, Sterilization.

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INTRODUCTION

Infection control is a major issue in medicine and dentistry because of concern over communicable disease transmitted in health care settings.¹ Microorganisms cause a variety of infections and diseases in the human body and are largely ubiquitous in nature.² Sterilization aims to eliminate all forms of life and other biological agents present in a specified region, such as a surface, a volume of fluid, medication, or in a compound, such as biological culture media. Different methods to achieve sterilization include use of heat, chemicals, irradiation, high pressure, and filtration. Dentistry today faces a

serious challenge to maintain patient's safety. A cleaning and sterilization process that meets American Dental Association and Centers for Disease Control and Prevention (CDC) guidelines is vital to an effective infection control program.³ Many methods of instrument reprocessing are available that fulfill all elements ensuring maximum efficiency and minimal risks.

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 include the cleaning and sterilization of reusable dental instruments and devices. Care must be taken by the dental health care professional to ensure that all instruments are cleaned prior to sterilization, and that this is carried out in a safe manner to avoid injury.⁴

CATEGORIES OF DENTAL INSTRUMENTS

Dental instruments are classified into three categories depending on the risk of transmitting infection according to the CDC.⁵

- Critical instruments penetrate soft tissue or bone, or enter into or contact the bloodstream or other normally sterile tissue. Sterilization is achieved by steam under pressure (autoclaving), dry heat, or heat/chemical vapor.
- Semicritical instruments do not penetrate soft tissues or bone but contact mucous membranes or nonintact skin, such as mirrors, reusable impression trays, and amalgam condensers.
- Noncritical instruments come into contact only with intact skin, such as external components of X-ray heads, blood pressure cuffs, and pulse oximeters.

All the mentioned instruments can be effectively sterilized by various agents as mentioned in Table 1.⁶

Table: 1 Agents used in sterilization

<i>Physical agents</i>	<i>Chemical agents</i>	<i>Gases</i>
Sunlight	Alcohols	Ethylene oxide
Drying	Aldehydes	Formaldehyde
Dry heat: flaming, incineration, Hot air	Dyes	
Moist heat: pasteurization, boiling, steam under pressure, steam under normal pressure	Phenols	
Filtration: candles, asbestos pads, membranes	Halogens	
Radiation	Phenols	
	Metallic salts	

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CLEANING OF DENTAL INSTRUMENTS

Mechanical cleaning minimizes handling of instruments. If procedures are used whereby hand scrubbing is necessary, heavy-duty (utility) gloves, mask, eyewear, and gown should always be worn while cleaning.⁷ Using locked cassettes eliminates the need to sort, handle, and hand scrub individual instruments, thereby reducing the risk of infection from contaminated instruments.

Ultrasonic Cleaning Devices

An ultrasonic cleaner uses a process called cavitation where 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.⁵

Instrument Washers

Instrument washers have been widely used in hospitals and large facilities as part of the central sterilization process.⁶

Instrument Disinfectors

Use high temperature of water and chemical additives to clean and disinfect the instruments. Instrument washers and thermal disinfectors are approved by the Food and Drug Administration.⁶

Packaging

Packaging used for instruments and cassettes prior to sterilization includes wrap, paper pouches, plastic pouches, combination paper/plastic pouches, and nylon tubing. Materials are specifically designed to allow penetration of heat, steam, or vapor and then to seal the sterilized instruments inside the package for sterile storage. After sterilization, instruments should remain in packages until use.⁸

BIOLOGICAL MONITORING

Biological monitors⁹ are a 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.

These monitors/indicators are utilized in evaluating the effectiveness of various sterilization agents which are discussed in Table 2.

Dry Heat Sterilization

It utilizes high temperatures for extended periods to achieve sterilization of instruments. Convection is the

Table 2: Types of indicators

Class 1 (Process indicators)	Placed outside of packs and are useful in determining which packs have been properly processed vs those that have not
Class 2 (Bowie-Dick indicators)	These show the pass/fail in prevacuum sterilizers
Class 3 (Temperature-specific indicators)	These react to one of the critical parameters of sterilization
Class 4 (Multiparameter 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

method of heat circulation in dry heat sterilizers, which ensure that the heat circulates throughout the sterilization chamber during the process. Mechanical convection is more effective as it continually circulates the heated air to maintain a uniform temperature throughout the chamber.¹⁰

Steam Autoclave—Gold Standard in Sterilization

Steam autoclaves are the most commonly used method in dental practices. The steam entering the chamber from the water reservoir displaces the air as it leaves the chamber.³ The combination of pressurization of the chamber, steam, and a high temperature for a prolonged period has the ability to kill virtually all microorganisms. A typical cycle for wrapped instruments includes heat-up and pressurization time, followed by a 15- to 30-minute cycle during which sterilization takes place (121°C at 15 psi). The sterilization cycle time decreases as the temperature is increased.⁵

Advantages of autoclaves: Autoclaving is the most rapid and effective method for sterilizing cloth surgical packs and towel packs. It is dependable and economical. Sterilization is verifiable.⁷

Disadvantages of autoclaves: Items sensitive to the elevated temperature cannot be autoclaved. Autoclaving tends to rust carbon steel instruments and burs. Instruments must be air dried at completion of cycle.⁹

REVIEW OF LITERATURE

Sierra and Boucher¹¹ studied ultrasonic synergistic effects in liquid-phase chemical sterilization and observed that rapid inactivation of bacteria may be achieved by using ultrasonic energy and aqueous alkalized glutaraldehyde solutions at low (25°C) or moderate (55°C) temperatures.

Palenik et al¹² did a survey in 218 randomly selected private endodontic offices in five states in America. The findings of this study indicated that sterilization failures occurred in private endodontic offices. None of the procedural methods or educational traits obtained from the study's survey could be correlated to sterilization success.

Kuritani et al¹³ did an *in vitro* study to determine the efficacy of chemical vapor sterilizers (chemiclaves), steam pressure sterilizers (autoclaves), and dry heat sterilizers on laboratory contaminated sponges. There were comparative results in all the groups.

Parkar and Johnson¹⁴ while analyzing the effectiveness of ethylene oxide for sterilization of dental handpieces suggested that adequate sterilization with ethylene oxide gas was not possible probably due to a biofilm entrapped within "clinical" handpieces (possibly the biofilm) and may protect bacteria from ethylene oxide gas preventing adequate sterilization.

Hurt and Rossman¹⁵ analyzed the sterilization of endodontic hand files. Six test groups of 15 files were studied using *Bacillus stearothermophilus* as the test organism. Groups were "sterilized" by glutaraldehyde immersion, steam autoclaving, and various techniques of salt sterilization. Only proper steam autoclaving reliably produced completely sterile instruments.

Burkhart and Crawford¹⁶ suggested critical steps in instrument cleaning and they demonstrated that there was a need for more research on instrument cleaning and sterilization. They recommended that instruments be thoroughly rinsed after cleaning and before sterilization.

Filho et al,¹⁷ while studying the use of ultrasound for cleaning the surface of stainless steel and nickel–titanium endodontic instruments, found that the use of ultrasound proved to be an efficient method for the removal of metallic particles from the surface of stainless steel and Ni–Ti endodontic instruments.

Gennaro et al¹⁸ discussed a new methodology for decontamination of dental instruments by an ultrasonic cleaner based on Sweep System Technology. The efficiency of a decontamination procedure by sonication for different dental instruments after experimental microbial and viral contamination was tested. The synergistic effect of chemical and physical means, as already accepted as an effective cleaning procedure of medical instruments, can therefore be applied to obtain a safe and effective sterilization of dental instruments that are potentially contaminated by organic fluids and dental material harboring pathogenic microbes and viruses.

Eralp et al¹⁹ evaluated various disinfectants on different types of contaminated dental materials in an *in vitro* study. It was concluded that cleaning the dental equipment thoroughly prior to disinfection would highly be effective since the microorganisms on dental instruments smudged with blood and saliva were found to be more resistant to disinfectants.

Schmid-Schwab et al²⁰ evaluated the cleaning efficacy of instruments for processing of handpieces. The results showed that initial flushing of water/air canals

with water before flushing with alcoholic solution was necessary.

Govoni²¹ discussed the role of ultrasonic cleaning solutions in dentistry and recommended that ultrasonic cleaning solutions should be changed daily. Since the solution is contaminated, items should never be placed into the solution or removed with bare hands.

INFECTION CONTROL MEASURES IN DENTAL PRACTICE

Preprocedural Mouth Rinse

The 0.05% cetyl pyridinium chloride when used as a preprocedural mouth rinse is equally effective as chlorhexidine in reducing the levels of bacteria generated during ultrasonic scaling.²²

Hand Sterilization

Hand asepsis is mandatory as it eliminates transient flora and reduces resident flora to prevent introduction of organisms in the operative wound. Watches and jewelry must be removed and hands must be washed with a suitable cleanser at the beginning of a routine treatment period.

Hand Cleansers

They have broader activity for special cleansing and it can be hazardous to eyes. Hence eye protection is essential. Povidone iodine (7.5–10% povidone iodine) is used as a surgical hand scrub. Parachlorometaxyleneol is nonirritating and recommended for routine use.

Personal Barrier Protection

They are 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 eyewear, surgical head cap, and overgarments.

Eyewear

Aerosols and spatter, sharp debris projected from mouth while using air turbine handpiece, ultrasonic scaler may cause eye injury. Injuries to eyes of patients may be caused by sharp instruments or by root canal irrigants during endodontic procedures. Hence eyewear both to the operator and patient is indicated.

Disinfection

A vital part of sterilization, disinfection is a two-step procedure that involves vigorous scrubbing of the surfaces to be disinfected and wiping them clean, followed

by wetting the surface with a disinfectant and leaving it wet for the time prescribed by the manufacturer. The ideal disinfectant should have a broad spectrum of activity, acts rapidly, noncorrosive, environment-friendly, nontoxic, and nonstaining and should ensure high-level disinfection.⁹

CONCLUSION

Infection control measures implemented effectively and efficiently are imperative to ensure maximum patient safety and reducing the risk of cross-infection. It is essential for the auxiliary dental staff to follow an appropriate segregation and sterilization of dental equipment. The dental staff must be adequately trained to understand various cleaning and sterilization devices and also identify which method would provide optimum result for which instrument/equipment. Although autoclave is still the gold standard for sterilization, focus should be made on newer advances like lasers for rapid sterilization and disinfection.

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