Review Article

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Dentistry Section

Sterilisation of Dental Implant Surgical Instruments, Office Area and Implant Components: A Narrative Review

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ABSTRACT

Implant surgical procedures require meticulous attention to sterilisation protocols to prevent infections and ensure successful outcomes. Various sterilisation methods, such as steam sterilisation, ethylene oxide sterilisation and hydrogen peroxide plasma sterilisation, are commonly used in healthcare facilities. Each method has its advantages and limitations and the selection of a sterilisation method depends on factors such as the type of implant material, instrument design and compatibility with the sterilisation process. Proper handling, packaging and storage of implant surgical components and instruments are essential to maintain their sterility until they are used. Healthcare facilities must follow standardised protocols and guidelines to ensure the effective sterilisation of implant surgical components and instruments, ultimately reducing the risk of infections and improving patient outcomes. Controversies exist regarding the reusability of healing abutments, with some advocating for single-use only to reduce the risk of contamination, while others argue for reusability under stringent sterilisation protocols. Further research is needed to establish clear guidelines on the reuse of healing abutments in implant surgery. The sterilisation of implant surgical components and instruments is a critical aspect of implant surgery that requires careful consideration of sterilisation methods and adherence to established protocols. Addressing the controversies surrounding the reusability of certain components, such as healing abutments, is essential to ensure patient safety and improve surgical outcomes.

Keywords: Healing abutment, Healthcare, Residual contamination of implant components

INTRODUCTION

Dental instruments are categorised according to their potential risk of infection, in accordance with the criteria for disinfection and sterilisation established by the US Centres for Disease Control and Prevention (CDC) [1]. The CDC classifies instruments that come into contact with bone, soft tissue and blood as critical items. Instruments that do not penetrate soft tissues or bone but contact intact oral tissues are classified as semi-critical. These devices should be sterilised after each use. Non critical items are those that come into contact with intact skin [2].

Critical items should be sterilised by heat before use because they carry an increased risk of spreading infection due to their penetration of soft tissue or bone. Heat-tolerant semi-critical items are also sterilised by heat, as they come into contact with mucous membranes or non intact skin; although the risk is smaller than that associated with critical items. If semi-critical items are heat intolerant, they should be cleaned with a strong disinfectant.

With the advent of cutting-edge technology and newer materials, implant therapy has become increasingly predictable [3]. Osseointegration is a biological phenomenon that can be successfully utilised for the rehabilitation of edentulous patients [4]. However, biological complications arising from the lack of proper sterilisation protocols for various implant components remain a challenging issue [5].

Resterilisation of certain implant components used in implant dentistry has been controversial due to patient safety, ethical issues and cost concerns. Opponents argue that the risks outweigh the benefits, while supporters believe that manufacturers label devices for single use primarily to maintain their profit margins [2,6].

The aim of the present review is to discuss the sterilisation of implant surgical instruments, the office area and implant components.

Classification of Instrument Based on Level of Infection

Spaulding EH, a prominent microbiologist, developed a classification system for medical devices and the level of disinfection or sterilisation required for each. This system, known as the Spaulding Classification, is widely used in healthcare settings. It categorises medical devices into three levels based on their intended use and the degree of contact with mucous membranes, non intact skin, or sterile tissues. This system has been instrumental in guiding healthcare facilities in implementing effective infection control practices [7].

The sterilisation and disinfection of the dental implant placement procedure can be divided into [3]:

1. Sterilisation of the Operating Theatre (OT)/office area
2. Sterilisation of implant surgical instruments
3. Resterilisation of dental implant components such as abutments, prosthetic parts, cover screws, healing abutments, impression copings, implant analogs and scan bodies.
4. Sterilisation of the operating theatre/office area [8].

A sterile method should ideally be used throughout any surgical treatment where there may be a higher risk of bacterial injury. This is especially important for any procedure in which the bacterial count needs to be lowered [8].

The most commonly used chemicals for high-level disinfection of the theatre environment include aldehydes such as formaldehyde, fogging with 8-10% hydrogen peroxide and hydrogen peroxide at 4-6% combined with silver nitrate. These chemicals are employed to ensure thorough disinfection and cleanliness in operating theatres, which is crucial for maintaining sterile conditions and reducing the risk of infections during medical procedures [3].

Light handles, X-ray unit heads, cabinets, drawer pulls, tray tables, chair switches and countertops should either be covered with

aluminum foil, plastic wrap, or absorbent paper, or disinfected regularly. This practice helps maintain cleanliness and hygiene in medical environments, minimising the risk of contamination and ensuring patient safety during procedures [9].

For site decontamination involving bloodstains or Other Potentially Infectious Materials (OPIM), sodium hypochlorite solutions are recommended. A 1:100 dilution is suitable for decontaminating non porous surfaces after a small spill of either blood or OPIM. However, if the spill involves large amounts of blood or OPIM, a stronger 1:10 dilution should be used for the initial application. These protocols ensure effective disinfection to mitigate the risk of contamination and maintain a safe environment in medical settings [1].

Sterilisation of Implant Surgical Instruments

Ensuring proper sterilisation of implant surgical instruments is crucial to prevent infections and ensure patient safety during dental procedures. This process involves meticulous cleaning, effective sterilisation using methods such as autoclaving or gas sterilisation and proper storage in sterile conditions. By following these techniques, healthcare providers can maintain the integrity and effectiveness of implant instruments, safeguarding patient health [10].

Most of the instruments used in implant surgery, such as mouth mirrors, explorers, tweezers, scalpel blades, periosteal elevators, retractors and implant surgical kits, are critical and pose a high-risk of infection. The different techniques for sterilisation of implant surgical instruments are shown in [Table/Fig-1].

General principles for sterilisation technique [8]

- Only sterile materials and instruments are to be placed within the sterile field.
- Check for chemical indicators to verify the sterility of items placed onto the sterile field, as well as for package integrity and expiration dates (if applicable).
- The areas above and below the sterile field table are considered non sterile.
- Materials that display a manufacturer's expiration date should be considered unsafe for use after that date.
- If any sterile item (material, instrument, gown, glove) has been compromised, the contents of the package, the gown, or the sterile field itself is considered contaminated.
- Single-use materials should only be used on an individual patient for a single procedure and then discarded.
- Reusable medical devices shall be reprocessed and sterilised according to the manufacturer's directions.

Instrument	Technique
Mouth mirror	Ethylene oxide: 450-800 mg Dry heat oven Chemical vapor: 20 minutes at 270° F
Dental handpieces	Autoclave [1] Ethylene Oxide (ETOX) gas or chemiclave (chemical steriliser) would typically be determined by following the manufacturer's instructions. Method • Water should be flushed through the handpiece by running it over a sink for about 20 seconds, followed by the removal of the bur. • To remove debris, scrub the handpiece with detergent, rinse it with water and then dry it. • It's advisable to use a lubricant recommended by the handpiece manufacturer for optimal performance. • After replacing the bur or hanging the handpiece in a handpiece rack, expel excess oil by running the handpiece for 2 seconds. • If the bur has been replaced, remove it. Clean the fiber-optic bundle ends with alcohol. Place the handpiece in a clear-view sterilisation pouch, along with a chemical indicator strip. • After the sterilisation cycle is complete, do not leave the handpiece in the steriliser. • Remove the handpiece from the bag, insert the bur and proceed with its use.
Air/water syringes and ultrasonic scalers	Autoclave [1] ETOX gas or chemiclave
Periosteal elevator BP handle Curettes Drills Implant driver Torque wrench Parallel pin	Autoclave [1] • Wrapped instruments should be exposed for: - 30 minutes at 250°F (121°C) - 15 minutes at 270°F (132°C) - Allow for a dry time of 15-30 minutes before use. • Textile packs should be exposed for: -30 minutes at 250°F (121°C) 25 minutes at 270°F (132°C) -Allow dry time of 15 minutes before use. • Wrapped utensils should be exposed for: -30 minutes at 250°F (121°C) -15 minutes at 270°F (132°C) -Allow for a dry time of 15-30 minutes before use.

[Table/Fig-1]: Different techniques for sterilisation of implant surgical instruments according to centre for disease control and prevention.

Resterilisation of Implant Components

Resterilisation is the repeated application of a terminal process designed to remove or destroy all viable forms of microbial life, including bacterial spores, to an acceptable sterility assurance level. The newly purchased implant components also come with instructions and must be sterilised by the clinician [11,12]. The reuse of these components has been supported in the literature as a means to reduce costs for both clinicians and patients [2,6,13]. In a study conducted by Browne V et al., no statistically significant difference was found between autoclavable newly purchased components and reused components [6]. Different methods have been advocated for reducing contamination, including precleaning with a microbrush, followed by immersion in either 5% sodium hypochlorite or 70% isopropyl alcohol, ultrasonic bathing and autoclaving [6,14,15]. Steam sterilisation, along with either chemiclave or mechanical methods, has been widely accepted as providing adequate sterilisation [2,6,13]. However, resterilised healing abutment surfaces may cause inflammation of the peri-implant mucosal cuff and compromise uneventful healing [2]. Additionally, the impact of repeated sterilisation on the functional integrity of implant components for reuse has been documented and a combination of disinfection and sterilisation techniques has been proposed [Table/Fig-2] [2,6,12-17]. Dunn has addressed the ethical concerns related to sterilising single-use items and outlined specific sterilisation procedures [18]. Furthermore, in dentistry, there are no

Component	Technique	Author's name	Summary
Healing abutment	General sterilisation principles and autoclave	Cakan U et al., [2] 2015	Healing abutments that have been sterilised and serviced by dental implant companies may still contain contaminants. Clinicians should clean them again and resterilise them before reuse to ensure safety.
	Steam sterilisation (121 degree 15 psi,15 minute) chemiclave sterilisation protocol (132 degree, 20 psi, 20 minute)	Browne V et al., [6] 2012	Used components showed sterility equal to new components without any visual distortion.
	The cleaning process involves mechanical wiping with disinfection cloths, followed by an ultrasonic bath in various solutions for 10 to 60 minutes. Finally, the components are autoclaved for sterilisation.	Wadhwani C et al., [14] 2016	Following cleaning and sterilisation, 99% of used healing abutments still have protein contamination at one or more sites.
	The three methods are: 1. Autoclaving alone 2. Autoclaving plus air-flow polishing with erythritol 3. Autoclaving plus sodium hypochlorite treatment	Chew M et al., [15] 2018	Autoclaving alone did not effectively decontaminate the items. Sodium hypochlorite treatment can be used in addition to autoclaving.

	4. Method Control group (ultrasonic cleaning and autoclave) Hypochlorite group Chlorhexidine group (12%) Airpolishing group Hydrogen peroxide group (3%)	Naghsh N et al., [16] 2024	The use of sodium hypochlorite and air polishing, alongside autoclaving and ultrasonic cleaning, effectively reduced residual contamination on the body surfaces of healing abutments.
Cover Screws	Citric acid, sterile water, hydrogen peroxide and CO_2 laser can be used individually or in combination for decontamination purposes.	Mouhyi J et al., [17] 2000	A sufficient level of decontamination was achieved.
Impression coping	Steam sterilisation (121 degree 15 psi,15 minute) chemiclave sterilisation protocol (132 degree, 20 psi, 20 minute)	Browne V et al., [6] 2012	Used components showed sterility equal to new components without any visual distortion.
Scan bodies	Autoclave 121 degree,15 psi, 15 minute	Kato T et al., [12] 2022	Autoclave sterilisation can cause some deformation in scan body.
	Autoclave 121 degree,15 psi, 15 minute	Hashemi AM et al., [13] 2022	Repeated use of scan bodies could potentially affect the accuracy of implant position transfer.

[Table/Fig-2]: Resterilisation of implant components [2,6,12-17].

published studies indicating that sterilising implant components negatively impacts the integrity of the implant placement or its success.

CONCLUSION(S)

Ensuring proper sterilisation is critical for both the success of surgery and the seamless integration of the implant. It minimises the risk of infections, thereby promoting better clinical outcomes. The presence of remnant tissue or bioburden can significantly prolong the healing process. When proper protocols are meticulously followed, the resterilisation of reusable components can achieve a prognosis comparable to that of new components. Thus, it is advocated that a successful prognosis in implant surgery can be achieved by following standardised sterilisation protocols.

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