

REVIEW ARTICLE

Instrument Sterilization in Orthodontic Clinic: A Review

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Abstract

Sterilization in dentistry is one of the prime importance and so is for orthodontics. This article offers practical guidelines and recommendations for effective sterilization in the orthodontic office keeping the instruments longevity in mind. Sterilization protocols are recommended for pliers, molar bands, elastomeric ligatures and chains, impressions and orthodontic appliances. Additionally a recommended sterilization protocol for the extremely stable group of infectious agents called prions is highlighted as well as its implication on instruments.

Keywords: Corrosion, Instruments, Pliers, Prions, Orthodontics, Sterilization

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Introduction

Sterilization in orthodontic office needs to be highlighted because protocols to be employed should have convenient adaptations that facilitated faster turnaround times and orthodontic instrument longevity. Matlack's review of orthodontic offices [1] confirmed few insufficiencies despite the fact that we are second only to oral surgeons in contracting infections like hepatitis in our offices. [2,3] Therefore an appraisal of the current sterilization protocols from an orthodontic perspective is outlined so that it would facilitate the budding orthodontist. Although the focus of this article is on sterilization protocols pertaining to orthodontic instruments and materials, it is hoped that these insights will guide the clinician towards the understanding and implementation of additional infection control measures with the overall office in mind.

Practical Guidelines for Implementing Instrument Sterilization in Orthodontic Office

Steps to asepsis- from infected instruments to complete sterilization.

Sterilization

It refers to any process that effectively kills or eliminates transmissible agents from a surface, equipment, article of food or medication, or biological culture medium. Sterilization can be achieved through the application of heat, chemicals, irradiation, high pressure or filtration.

Disinfection

May be defined as cleaning an article of some or all of the pathogenic organisms which may cause infection. Disinfectants are antimicrobial agents that are applied to the nonliving objects to destroy micro-organisms.

The advice sheet issued for infection control in dentistry issued, from the Department of Health, United Kingdom enumerates three stages to sterilization or decontamination process are; pre-sterilization cleaning, sterilization and storage. [4] The recommended guidelines for orthodontic sterilization requirements are outlined for maximum effectiveness while preserving instrument integrity. A designated area within the clinic setting facilitates sterilization protocol where pre-fixed disinfection and storage areas will demarcate as well as segregate the contaminated from the

sterilized and ready to use instruments. Additionally, water used should be free of contaminants and of the highest filtered quality (Ro Systems) for rinsing of instruments. Drying protocols involving compressed air must be from oil-free sources. The following equipments are deemed as essential requirements for implementing and maintaining effective infection control standards in an orthodontic office:

1. *Ultrasonic cleaning Unit (for debridement and pre-cleaning protocols)*
2. *Autoclave Sterilizer*
3. *Dry-Heat Sterilizer*
4. *Ultraviolet cabinet*
5. *Chemical immersion or cold sterilization*
6. *Glass Bead sterilization*

Ultrasonic Unit (for debridement and pre-cleaning protocols)

Ultrasonic units are the present day protocols for the pre-cleaning of hand instruments. They enable the bypass of debridement under running water by direct pre-cleaning in specially designed containers and cassettes.[5] Solutions with anti-rust compositions and enzyme based for breakdown of contaminants and particles is recommended. Pre-cleaning cycles last for 5- 15 minutes depending upon instrument load. It is crucial that any traces of residual moisture are eliminated through appropriate drying measures (compressed air) after the pre-cleaning stage. Presence of moisture in between the joints and tips of pliers increases the corrosive tendency in instruments.

Autoclave Sterilizer

It is the Gold standard for the effective sterilization. Instruments are subjected to steam under pressure (15psi) at a temperature of 121⁰ c to 134⁰ c (250⁰ F-273⁰ F). Conventional method involves holding time of 15 minutes for 121⁰ c. Rapid cycle involves 134⁰ c for 3 minutes. A cooling down period of 40 minutes to 1 hour for rapid and conventional cycles is required. Comparative studies on various sterilization protocols have reported the occurrence of corrosive changes with repeated cycles. [6] The presence of steam vapor has been found to be detrimental for orthodontic pliers.

Dry-Heat Sterilizer

It is the best suited means of sterilization for orthodontic needs due to absence of moisture. It causes oxidative destruction of bacterial protoplasm at a temperature range of 160⁰ c (320⁰ F) for 2 hours duration to achieve complete sterilization. Rapid Dry-Heat sterilization involves cycles at temperatures of 190⁰ c(375⁰ c) for 6 to 12 minutes. Instruments must be dry before sterilization, as the presence of water will interfere with the process. The absence of moisture is beneficial for the longevity of Orthodontic pliers, the cutting surfaces; there by making advantageous over other sterilization protocols. [7-10]

U. V Cabinet

After sterilization, instruments must be kept inside the ultraviolet cabinet so that sterilization of instruments is maintained for longer duration without any contamination. U V radiation is an enclosed space for the disinfection of dental instrument and orthodontic pliers with 6 exposures of 5 minutes duration according to the manufacturer's instructions. The optimum wavelength for U V radiation is 260nm during peak emission. The range of 254 nm is suitable for adequate sterilization.

Chemical immersion or cold sterilization

Recommended only for heat- sensitive non surgical instruments and alginate impressions. 2% acidic glutaraldehyde (Banicide) and chlorine dioxide are commonly used sterilants which are ADA approved. Sterilization time with 2% acidic glutaraldehyde is 10 hours without dilution and with chlorine dioxide (Exspor 4:1:1) is 6 hours. Comparative studies have indicated that cold sterilization predisposes to a pitting type of corrosion compromising the integrity of the instrument. [11, 12]

Glass Bead Sterilization

It is mainly used to sterilize the orthodontic bands and plier tips. They use small glass beads ranging from 1.2 to 1.5mm in diameter. The heating range is 424⁰ F to 450⁰ F(217⁰ c to 232⁰ c) for 3-5 seconds but not exceeding 482⁰ F (250⁰ c). Protocol involving molar band sterilization reported spore effectiveness at 226⁰ c after 45 seconds for a single band. [13] The larger the instrument, the longer the heat-up time required (1-2 Orthodontic pliers within 30

seconds). [14] These recommendations are deleterious as the instruments are exposed to higher temperature ranges against most manufacturer warnings (380⁰ F/193⁰ C). The suggested list is recommended for all primary instrument sterilization protocols. Secondary protocol involving chemical disinfectants as well as alcohol based wipes is recommended only for instruments and materials which do not come into direct contact with the patient and where cross contamination risks are not involved.

Orthodontic Plier Sterilization

The sterilization protocols employed for orthodontic pliers have been reported to affect the physical and mechanical characteristics. Enumerated below are current recommendations with effectiveness against organisms as well as the longevity of the instrument in mind. Guidelines for Sterilization of Orthodontic Pliers:

1. *Ultrasonic cycle for 5 to 12 minutes depending on the capacity of the unit.*
2. *Rinsing with distilled Water.*
3. *Remove excess moisture thorough drying with Compressed Air (Oil-Free).*
4. *Lubrication of Plier joints and cutting surfaces with silicone based lubricants.*
5. *Sterilization protocol using a Dry-Heat Sterilizer at 190 0 c (375 0 F) for 6 to 12 minutes with the placement of pliers in an open.*
6. *Storage.*

The recommendation of a final rinse with Distilled water following any pre-cleaning protocol is recommended to offset the impurities present in tap water as well as the possibility of ionic imbalances present with automated, cleaning solutions. Additionally silicone based lubricating sprays can be used for pliers before the dry-heat process and also after if the instrument is to be stored. Oil-based lubricants are not recommended as they tend to clog the pliers. Autoclaving is recommended only if a dry heat sterilizer is not available and only as a secondary option to dry heat sterilization. A shorter cycle at 134⁰ for 3 minutes is recommended due to the detrimental nature of the process on instruments. Instruments must be wrapped prior to the process after ensuring complete absence of moisture in the instrument.

Prion protection – Sterilization protocol for Orthodontic pliers

Prions are an extremely stable group of infectious agents that are resistant to conventional sterilization protocols. They are composed primarily of protein and are hypothesized to infect and propagate by refolding abnormally into a structure. Then, this converts normal molecules of the protein into an abnormally structured form. This altered structure is extremely stable making it resistant to destruction by chemical and physical agents conventionally employed. For Prion elimination, recommendations have advocated autoclave cycles at 121⁰ for 60 minutes or 134⁰ for at least 18 minutes or combination cycles involving hot-air sterilization followed by autoclaving to improve the margin of the safety. The effects of such extreme prion sterilization protocols on orthodontic pliers were evaluated recently were ligature cutters were sterilized through a protocol involving disinfection followed by a water disinfectant, hot air drying and finally autoclaving at 134⁰ for 20 minutes followed by a cooling period of 1 hour. The study observed that surface alterations occurred from the first cycle itself with a blunting of the cutting edges and a resultant decrease in their cutting efficiency. [15]

Molar Bands

Molar bands are one of the most overlooked materials in the orthodontic armamentarium. The sterilization of tried in pre-formed bands has received attention. [16,17] Recommendations for sterilization of Pre-formed orthodontic bands are listed below. Guidelines for Sterilization of Molar Bands:

1. *Ultrasonic cycle for 5 minutes depending on the capacity of the unit.*
2. *Rinsing with distilled Water.*
3. *Remove excess moisture through drying with Compressed Air (Oil-Free).*
4. *Sterilization protocol using a Dry-Heat Sterilizer at 190⁰ c (375⁰) for 6 minutes.*
5. *Storage.*

A recommendation for tried in bands is to process them through an ultrasonic cycle and store them in separate containers if they cannot be sterilized immediately. Additionally while sterilizing these bands it is important to ensure that they are processed separately from the in-

received bands. Autoclaving of preformed molars bands can also be carried out as an alternative to dry heat sterilization as the smooth surface of the band does not leave any scope for moisture retention; and additionally because they can be wrapped and marked if both in-received and tried-in bands are to be sterilized in the same sterilization cycle. Pre-formed bands having welded counterparts are not recommended for autoclaving. It is recommended that chemical immersion protocols be limited to bands without pre-welded attachments if conditions necessitate its use. Longer time duration required as well as the lack of any indicator for its effectiveness makes it a less than secondary choice for sterilization.

Elastomeric Ligatures and Chains

Elastomerics and elastomeric ligatures are not suited for chemical disinfection as they are known to alter the physical characteristics. [18, 19] Alcohol wipes are not an alternative as they are not effective in the presence of tissue proteins seen in blood and saliva. Single patient packs are the best insurance against cross-contamination risks at present and where this is not feasible as in the case of e-chain spools, it is better to cut a little extra than required and discard the rest.

Alginate impression and Orthodontic Appliances

Common disinfecting solutions that are used for alginate materials include 1% sodium hypochlorite, sodium dichloroisocyanurate and 2% glutaraldehyde. Present recommendations involve the immersion of alginate impressions for not more than 10 minutes in disinfecting solutions as alterations in surface characteristics have been observed with prolonged immersions. [20] Impressions for not more than 10 minutes in disinfecting solutions as alterations in surface characteristics have been observed with prolonged immersions. [20] Guidelines for sterilization of alginate impressions:

1. *Rinse thoroughly under running water following removal.*
2. *Immersion of impression in disinfectant for 10 minutes. Spraying aerosols are not recommended for their unevenness and additional inhalation risk.*
3. *Rinse again under running water.*
4. *Ready for model processing.*

Following this the impression can be processed for model fabrication. Additionally this recommendation is suited for orthodontic appliances as well. If there is an Orthodontic recommendation for this form of sterilization then it would be for disinfecting alginate impressions with the precaution that the immersion time be limited to 10 minutes to preserve dimensional and surface integrity. Studies indicate combining these agents with alginate impression materials enabling a low pH having anti-viral activity against the herpes simplex virus which additionally releases nitric oxide, a broad spectrum antimicrobial agent. [21]

Summary and Conclusion

The current and most efficient sterilization protocols from an orthodontic perspective can be summarized as follows:

Orthodontic pliers and Molar bands are pre-cleaned in an ultrasonic cleaner followed by proper drying using compressed air and then dry heat sterilization method and storage in a U.V.cabinet. This technique ensures complete sterility as well as longevity of instruments. Elastomeric Ligatures and Chains are best single used. Any form of chemical sterilization has shown to alter the properties of that material. Current recommendations involve the immersion of alginate impressions and Orthodontic materials for not more than 10 minutes in disinfecting solutions as alterations in surface characteristics have been observed with prolonged immersions.

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