

Sterilization and cross-infection control in the dental practice

Sterilization and cross-infection control is a core compulsory or recommended dental CPD (continuing professional development) topic in most European countries.

Educational aims



The overall aim of this module is to inform and educate the dental professionals on the basic principles of cross-contamination barriers and infection control measures in the dental health care facility.

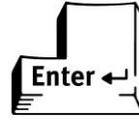
Expected outcomes



On completion of the module, the dentist:

- will have knowledge of the importance of appropriate protection of the dental personnel through meticulous hand washing, gloving and dental clothing
- will be able to perform the best practice techniques related to the management of contaminated surfaces and instruments
- will be able to apply appropriate cleaning, decontamination and sterilization protocols
- will have fully understood the importance of cross-contamination barriers on the overall patient safety
- will be informed on the currently existing protocols on the issue

1. Taking protection measures prior to beginning work



The dental staff must do the following before performing any dental work:

- Get vaccinated against hepatitis B – **It is an imperative.**
- Take a detailed medical history. This is necessary to find out if the patient has been through some kind of active contamination or other diseases indicating immunosuppression or other systemic illnesses. Independently of the information you have collected from your patient, you must consider him/her **potentially contaminated and take the precautions advised for all patients.**
- Make sure **all the instruments are sterilized.** Any instruments used to penetrate soft tissues or bones, such as tweezers, chisels, cleaning scoops, scrapers, must be sterilized after use.
- Protect **working surfaces.**
- Make sure they have at **their disposal all the disinfectant fluids** and waste containers necessary.

2. Hand washing

Hand washing is the cornerstone of the 'patient – doctor – auxiliary staff' protection circle aiming at the prevention of cross infection.



The dental personnel is obliged to wash their hands **before and after coming in contact** with the patient (or the instruments used) independently of wearing gloves or not during the operation.

Hand washing must be performed meticulously so that every hand surface is adequately cleaned. Special attention must be paid to hand surfaces usually neglected when washed.

The pictures illustrate the areas requiring special attention so that hands are properly cleaned.







Various methods for drying hands

After removing the gloves, hands must be carefully washed as very often there are pores in latex allowing the penetration of contaminating matter.

Although frequent hand washing is a necessity, sometimes problems may appear such as dry skin and dermatitis. To avoid such problems special moisturising lotions are recommended. These lotions, moisturising creams etc. should be applied at the end of the day as they may cause the gloves to develop pinholes, due to their chemical composition, in which case no protection is offered by the gloves.

In most kinds of dental work, **water and soap** followed by an antimicrobial solution are sufficient. In case of an injury, scratch or exudative injury, the person should postpone treating patients until the wound is healed. If this is not possible, the use of a double pair of suitable and tolerable gloves is recommended. As regards to antimicrobial solutions, although their use is not required, solutions with prolonged action are preferable.

Their contribution to hand antisepsis is significant as pinholes may pre-exist or develop when the gloves are in use allowing the penetration of oral fluids and blood. When an antimicrobial solution remains effective for a long time after its application, adequate hand protection from the development of germs on the skin surface below the gloves is provided.

Using antimicrobial solutions without prior meticulous hand washing is a defective and inefficient procedure.

Alcohol antiseptic solutions or gels are effective in destroying the germs on the hand surface, provided that their use is preceded by adequate cleaning.

It should be noted that a solution can have a prolonged antiseptic action only if it contains an antiseptic agent such as chlorhexidine, quaternary ammonium compounds, octenidine or triclosan.



- Hand washing before and after patient contact is absolutely necessary
- Antimicrobial solutions contribute to hand antisepsis
- Solutions are not used are the only antiseptic means

3. Gloves



The medical and auxiliary staff is obliged to always wear latex (or vinyl or nitrile) gloves during any dental work which involves contact with blood or saliva containing blood or mucus. These gloves should not necessarily be sterilized unless an operation is going to take place, particularly on patients with HIV infection.

Hands must be meticulously washed before wearing gloves.

The same procedure must be followed after removing gloves. Gloves are used during any dental work, for a single patient only and, afterwards, they are removed and discarded.

Washing the gloves and performing any dental work to another patient is strictly forbidden.

Sterilizing examination gloves is also not allowed as manufacturally there is no guarantee of the protection of their integrity. Disinfection fluids, essential oils, acrylic monomers, various dental materials and instruments, several skin soaps and lotions may distort the cohesion of the glove material.

In patients with confirmed HIV or HBV and HCV infection, it is recommended that **double gloves** are used for the protection of the surgeon. If during any dental work it is necessary to use an extra device or material, gloves should be covered with an extra pair of nylon gloves so that contamination of those surfaces is prevented.

More often than not, aphyllactic responses, at various levels, have been recorded due to latex gloves.

In such cases the exact cause of this response must be searched (latex, talc, maize powder) considering, also, agents facilitating aphyllactic (anaphylactic?) responses (humidity). Finally, appropriate hypoallergic gloves or vinyl/nitrile gloves should be provided. If there are injuries, scratches or exudative injuries and the operation cannot be avoided, double gloving is recommended for extra protection.



- Hand washing is necessary before wearing gloves
- Gloves are discarded after each patient
- Double gloves are recommended for patients with HIV, HBV, HCV infection

4. Mask and glasses

During the examination or any dental work, an appropriate mask and eye protectors are necessary. These masks must follow certain specifications regarding the size, the thickness and the material, excluding those designed for structural or technical occupations due to intense particle penetration ability.



Masks must be able to withhold at least 95% of the microorganisms.

In case the dental patient suffers from an airborne disease (tuberculosis), the mask must be enhanced and fully adaptable to the wearer's face. Also, it must be able to withhold particles and microorganisms with a diameter up to $1\mu\text{m}$, at a percentage of 95% (aspirator N95, FFP3). If the mask gets wet it must be immediately discarded and replaced.



Mask, glasses and head cover

Eye protectors may include various types of glasses or plastic masks or shields made of transparent materials. The side frame should be wide enough to cover adequately the eye.

These protectors must be rinsed with abundant water and get disinfected in case they get stained in between the patients.



- Masks and eye protectors enhance dentist and patient safety

5. Dental clothing & Surface coverings

Blouses should cover a big part of the dentist's body and hands.



They must be changed on a daily basis and definitely as soon as they get stained.

If the operation is expected to involve a large amount of bleeding or the patient is likely to be seropositive, it is highly recommended that specially designed single-use clothing be used.

Reusable clothing must be washed in a machine washer at an appropriate temperature, using a detergent and always separately from domestic and non-medical clothing.



Appropriate dressing for high risk patients

Surface coverings

Any surfaces, devices, electric switches, door handles, drawer knobs, taps, handles and device tubes not able to be sterilised or disinfected, should be meticulously covered with appropriate materials, such as:

- special rollers and plasticized paper sheets,
- cellulose film,
- aluminium foil,

- self-adhesive films,
- nylon cases,
- latex and vinyl cases.

These protective coverings should be replaced after every contact and every patient



- Dental blouses are changed daily and washed separately
- Surfaces not being able to be sterilized are covered with appropriate material



Unit surfaces cover



Headrest cover



Handpiece cover



Air-water syringe cover

6. Cleaning and Sterilization of dental instruments

Any dental hand instrument used during a dental incident must undergo a cleaning and sterilization procedure.



Step 1. Right after the completion of the incident (examination, restoration, surgery) the instruments must be discarded in a special plastic container filled with an appropriate **disinfectant solution** or enzyme solution with a proteolytic action.

Step 2. After leaving the instruments within the solution for as long as the manufacturer recommends, they are transferred to the **machine washer** where they undergo thorough mechanical cleaning using the appropriate detergents. If dental materials (cements, pastes, oxides, etc) have been fixed on the instruments, the latter must be cleaned with ultrasonic devices and appropriate solutions.

Manual cleaning is not recommended due to the high risk involved in causing injuries and because it is inferior to mechanical cleaning in terms of quality.

Step 3. After the instruments have been cleaned, they are packaged in special bags or perforated cassettes and they are taken to the **autoclaves** to be sterilized.

*The autoclave is programmed to operate depending on the packaging of the instruments and according to the default parameters set by the manufacturer, e.g. 134°C for 3 minutes or 121°C for 20 minutes or 121°C for 13 minutes, etc. it should be noted that the above times **do not include** warm up or air removal. The completion of the cycle and the sterilization process is confirmed through electronic instrument indications as well as changes in the color or shape of the indicators.*



Autoclaves

6a. Single use instruments

These instruments are divided into two categories:

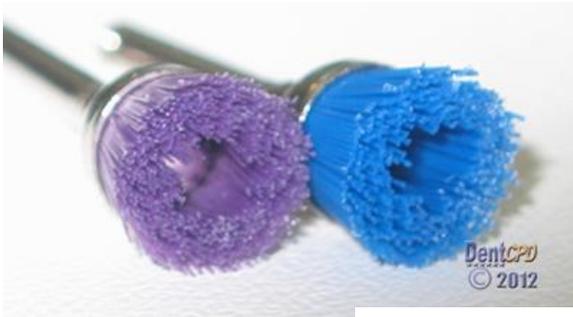
- **Obligatory single use instruments. They can only be used once and be discarded afterwards.**
Anesthetic needles, Scalpel blades, Suture needles, Saliva ejectors, Dental cups, Surgical suction nozzles, Pulp instruments, Wedges, Rubber cups, Artificial walls, Fluoride gel trays.
- **Optionally single use instruments**
Certain mirrors, Artificial wall retainers, Napkin holders, Various types of burs, impression trays, Material mixing pads, Low speed handpieces for polishing after cleaning, High speed handpieces for cavity and stump formation in seropositve patients.



Single use disposable needles for etching



Single use wood wedges



Single use brushes



Disposable single use examining set

6b. Use and care of sharp instruments and needles

Sharp instruments, having been in contact with blood and saliva, should be used with special care so that injuries are prevented.

Place any surgical blade and needle within a solid, hard plastic container for sharp instruments. Do not cap, bend or destroy the needles before you discard them. Do not overfill the plastic container, close tightly and, finally, discard.

Used needles must not be recapped with both hands or any other technique and care must be taken so that the needle does not point towards the body. The 'one hand' technique to recap the needle or a mechanical means designed to hold the cap should always be used. Recently, the use of needle destroyers which melt the metallic edge of the instrument has been suggested.



One-hand technique to recap the needle



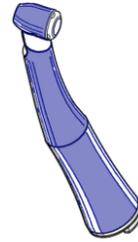
Mechanical means for holding the needle



- Dental instruments must undergo a cleaning and sterilization procedure
- Sharp instruments and needles must be managed with special care

7. Sterilization of handpieces and burs

Low and high speed handpieces as well as various burs used in everyday clinical practice should be sterilized before use so that all conditions ensuring harmless dental care provided to all population groups are met.



Sterilizing the handpieces requires special attention and suitable preparation so that any damages to their interior are avoided and, consequently, defective operation and financial burden are prevented.

After the completion of any dental work, the external surfaces of the handpiece have come in contact with saliva, blood, dental tissue debris and residues of dental materials. However, it is likely that the internal tubes of the handpieces are infected due to various hydrodynamic phenomena taking place on their tip:

- *when cavities are formed subgingivally,*
- *opening up a coronal cavity during endodontic therapy,*
- *forming stumps,*
- *polishing gingival restorations,*
- *polishing the cervical areas of the tooth after a periodontal treatment.*



Brushing the handpieces

Several ways to control the spread of contaminating matter between two patients have been recommended. The most common methods of asepsis control are the following:

- Protection from any contact with the fluids existent in the oral environment
- Chemical disinfection
- Thermal sterilization
- Disinfection using microwaves
- Disinfection via irrigation
- Single use handpieces

Among the above techniques, moist heat using saturated water vapours (autoclave) offers the best results as regards the sterilization of handpieces in a very short time.

7a. Sterilization of handpieces

Step 1. After the end of the dental work the handpiece **must operate** for 5-10 seconds over the wash basin or a similar container while ejecting water and air.

Step 2. Then, after being detached from the tubes connecting it with the unit it must be meticulously **washed and brushed** under running water.

Step 3. Finally, it must be **dried** with an absorbent paper.

Step 4. After external cleaning, the handpiece is reconnected to the tubes and operates for 3-5 seconds only with air so that any water residues are removed from the interior of the tubes and the impellers.

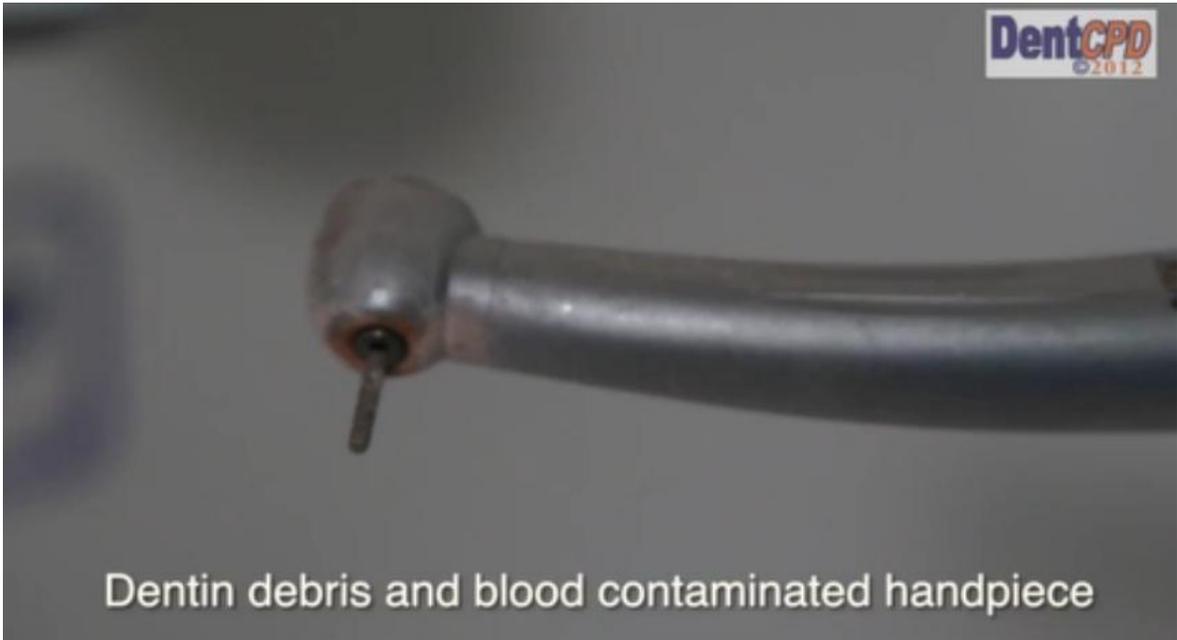
Step 5. Then, the handpiece is **lubricated** with the lubricant recommended by the manufacturer and operates again for 10-20 seconds only with air so that the lubricant is properly distributed throughout the sensitive areas of the head.

Step 6. After the end of this procedure, the handpiece along with the burr extractor are **enclosed in a special pouch** airtightly sealed either with a self-adhesive tape or a thermosealer.

Step 7. The handpiece is placed in the autoclave where care should be taken for the pouches not to be clambered so that the air passes unhampered.

The pouch with the handpiece must also include a sterilisation indicator which could be either a special tape or a vial with carbon grains. This is not necessary if the pouch includes a system controlling the length of stay and the vapour temperature within the autoclave. Depending on the manufacturer's indications, the autoclave is programmed to operate at 121°C for 20 minutes or at 127°C for 13 minutes or at 134°C for 3 minutes. After these cycles have finished and after the indicators have confirmed that the conditions worked properly, the handpieces and the extractors are sterilised and are ready to use.

Step 8. Right before using them, some handpieces must be **lubricated again** with an appropriate lubricant which, this time, must be either sterilised or new and generally different from the one used to lubricate the septic handpiece before being placed in the autoclave.



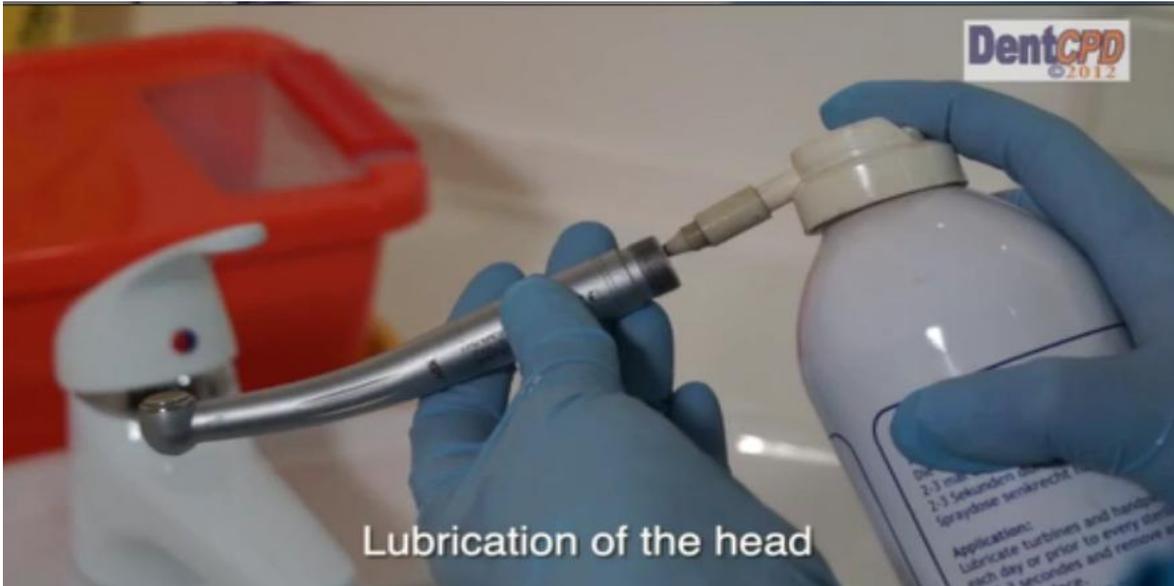
Dentin debris and blood contaminated handpiece



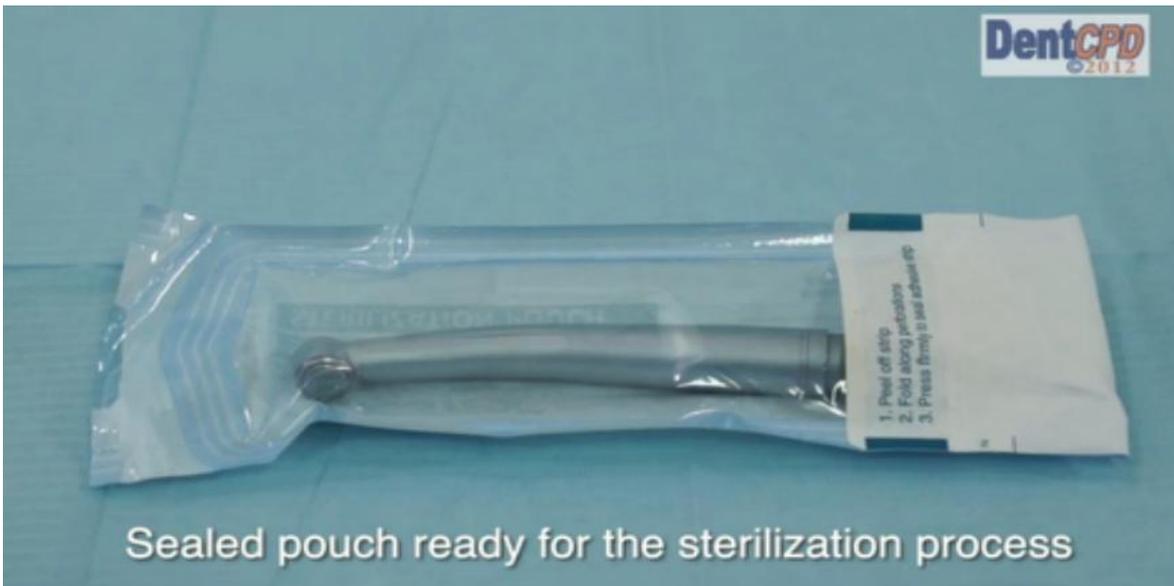
Water flushing under the tap water stream



Drying with absorbent paper



Lubrication of the head



Sealed pouch ready for the sterilization process

7b. Sterilization of burs

Burrs should be sterilized independently of their type or mouth area they have worked in.

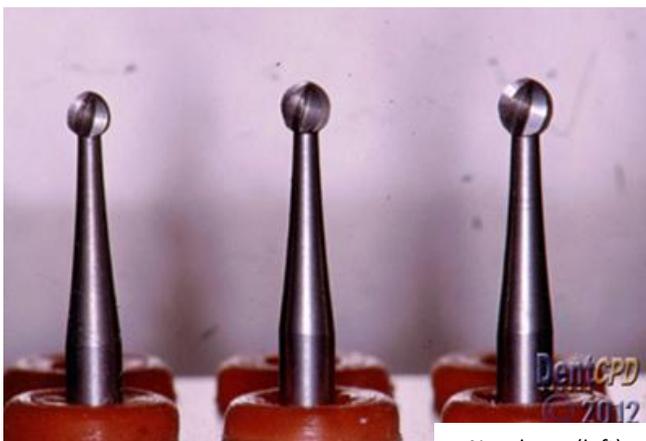
Step 1. A necessary step prior to sterilizing a burr is **meticulous cleaning** from tooth tissue debris, residues of dental materials, blood clots or a paste-like mixture of all the above with saliva. The most widely accepted cleaning method for burrs and other micro instruments are **ultrasonic devices** (baths) using suitable fluids and with the addition of enzymes with proteolytic action.

In these baths using suitable fluids at a temperature of about 60°C, burs vibrate at a frequency of 60-80 kHz for at least 15 minutes. After the end of this procedure, burs are free from foreign matter as well as oxides very often being deposited on their stem.

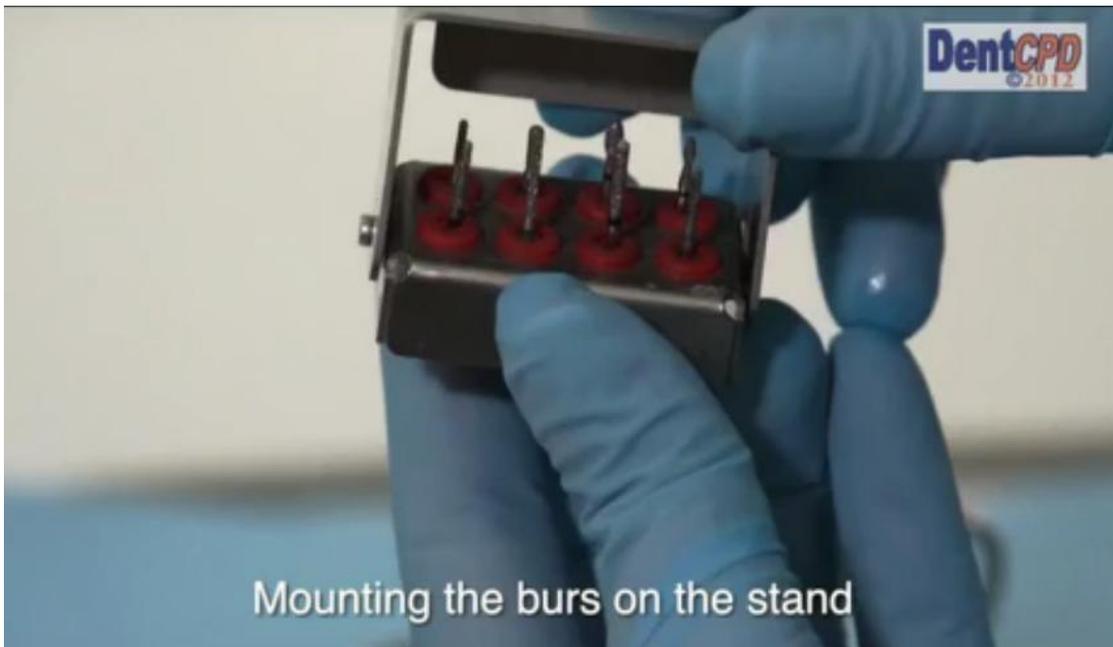
Step 2. After taken out of the ultrasonic bath, burrs must be **dried** using an absorbent paper and hot air.

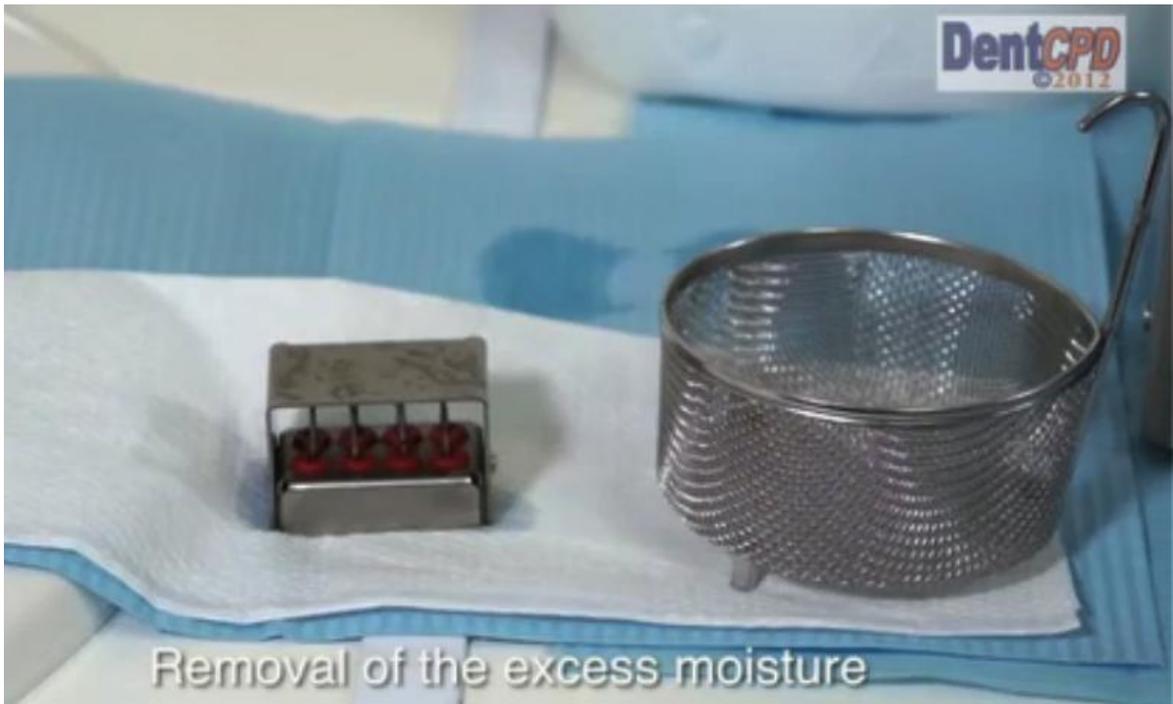
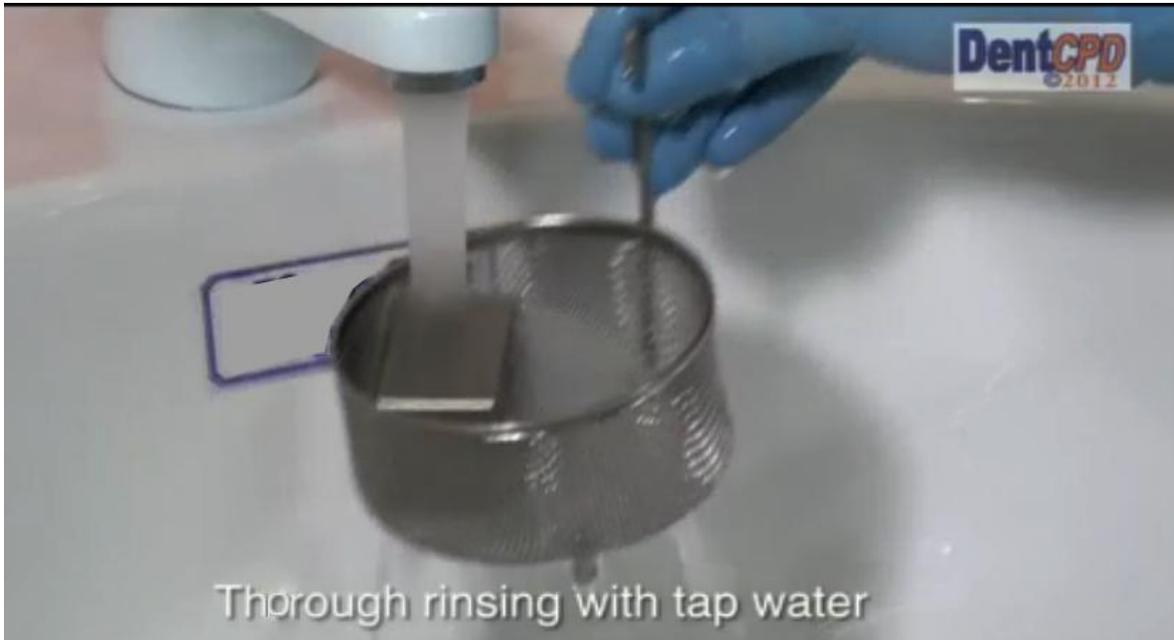
Step 3. They must be placed in an appropriate **device for sterilization**, depending on the material they are made of:

- 1) burrs made of common carbon steel should not be placed in the autoclave because they are oxidized.
- 2) on the contrary, burrs made of stainless steel or tungsten carbide are not affected.
- 3) dry heat ovens, ovens for chemical vapour sterilisation and ethylene oxide ovens are suitable for sterilising all types of burrs. However, dry heat ovens, due to prolonged heating involved, may seriously damage the cutting edge of the burrs.
- 4) using various aldehydes and phenols for at least 30 minutes offers adequate sterilization while after 10 hours chemical sterilization is achieved. Nevertheless, they may damage the integrity of rotating cutting instruments.



New burs (left) and damaged burs after repeated usage and sterilization (right)





NOTE: It is a fact that no technique can fully remove organic debris and, therefore, result in successful sterilization. For these reasons, burs intended for single patient use and discarded afterwards have recently been introduced.

8. Preparing impressions for the Lab

- After removing the tray from the oral cavity, all impressions must be cleaned and sterilised in a certain way and using suitable solutions.
- More specifically:



Step 1. After making the impression the tray must be transferred to the wash basin where the flow of tap water will remove any visible organic contaminants (blood, saliva etc.).

Step 2. Afterwards, the tray is sprayed with or immersed in a suitable disinfectant solution depending on the properties of the material each impression is made of.

Step 3. Impressions must be packaged in a suitable plastic box or a pet bag so that they are safely sent to the dental lab.



Single use plastic box for casts



Transportation

9. Taking protection measures after ending work



- Before you clean the working surfaces, **wear thick work gloves**, so that your hands are covered and are not exposed to blood and other biological fluids left on surfaces or instruments.
- **Remove any protective cover.** If the cover has been stained with blood, place it in a red bag. If the blood is completely dry or the cover has not been contaminated, place it in a regular bag. Use absorbent paper in case blood has penetrated the protective cover and put the absorbent paper in the red bag. Use an appropriate disinfectant.
- **Clean and sterilize all the instruments** and **disinfect the working surfaces** with an appropriate disinfectant solution (phenolic, alcoholic, quaternary ammonium compounds).
- Sterilize in the autoclave or dry heat oven any instruments having been in close contact with tissues. A special tape indicating that they have been sterilized must be attached on the instruments so that one is sure that sterilization has been carried out. This procedure is performed by specialized personnel.
- All **handpieces must be sterilized** in between patients. Follow the instructions recommended by the manufacturers. Chemical sterilization is not safe. Ultrasonic handpieces, scrapers and air syringes must be washed and sterilized. This procedure is performed by specialized personnel.
- **Place and remove any used waste.** All plastic bags must be collected on a daily basis to prevent the spread of infectious diseases.
- **Clean and disinfect the impressions.** Any impression or mapping should not be sent to the lab before being cleaned or disinfected.
- Remove your gloves and **wash your hands** with a disinfectant and water. If more patients are waiting to be examined, place back the protective covers and repeat the procedure.

10. What must be done in case of an accident and exposure to infected material

Although the transmission probability of HIV after an accident is below 0.5%, it is imperative that protection measures are taken. In case of professional exposure to HIV after been pierced with an infected needle or other sharp instrument used on a patient diagnosed with HIV infection, the following actions must be taken:



- Prompt and meticulous washing of the injured area.
- Immediate placing of a gauze with a disinfectant solution on the injury (e.g. Cidex, formaldehyde, povidone iodine or 75% alcohol etc.) for at least 15 minutes.
- The professional must be examined as soon as possible. HIV can be detected in antigen presenting cells and peripheral ganglia within 72 hours after the infection while viraemia develops in about five days. The latter allows a 72-hour-period within which treatment can be provided.
- Chemoprophylaxis with antiretroviral drugs must begin as soon as possible after the incident. After 72 hours have passed, there is no point in administering chemoprophylaxis medication.



Position of the handpieces to avoid potentially harmful incidents

Post exposure prophylaxis, PEP

- Depending on the size of the injury and the viral load of the patient two or three antiretroviral drugs are used (two nucleosides with the addition or not of a protease inhibitor). These same drugs are used to treat HIV infected people.
- Chemoprophylaxis with antiretroviral drugs lasts four weeks and has a 80% chance of success in preventing seroconversion.