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Cleaning

A crucial step in the reprocessing workflow of medical devices and instruments

Although cleaning might be considered the first step in reprocessing, it is vital to remember that the first step in the decontamination cycle is acquisition of the instrument or device. This means that BEFORE you buy any new dental equipment you MUST check that the re-processing of your instrument or device described in the IFU is compatible with the processes in your dental office. If they are then you can proceed ...

Whether performed mechanically or manually, the cleaning of used medical instruments is a critical step in the process. The general principle of cleaning, was summarized by Herbert Sinner in 1959 in a simplified way in the so-called Sinner Circle.

The concept of Sinner's Circle is that all the critical components must be optimised for effective and efficient cleaning. Being an employee of Henkel, Herbert Sinners principles were based on the different factors to improve the cleaning of clothes. The same is true for the cleaning of dental instruments, but optimised to remove micro-organisms, blood, saliva and other contaminants. It is important to remember that even an optimised Sinners circle will not remove dental cement or liners that have set on dental instruments, these must be removed at chair side. Since any residual material left on instruments after dental use may reduce the probability of achieving sterilization conditions. Also, contamination remaining after cleaning can substantially affect the lifespan of instruments. Examples of this are blocked spray channels in handpieces, or instrument gear parts that are hard or impossible to operate due to dried on contamination. It is helpful to visualise the adverse effect of heating (in the sterilizer after incomplete cleaning) any remaining tissue or body fluids that remain will act like old-fashioned glue on or in instruments.

Automated cleaning using **AWD's** is the most efficient and staff safest method for instrument cleaning.

If these machines are unavailable then practice staff must exercise particular caution here; the risk of contamination is high, particularly in the event of heavy contamination with blood. It is essential that appropriate protective clothing, gloves and masks be worn and that staff have documented training and competency assessments in this task.

How clean is clean?

The answer to this question is still debated by subject-matter experts, and they have defined a number of chemical or biochemical tests to help inform this decision. These can be found in the **standard ISO EN 15883-5.** Examples of some suggested criteria include:

Protein assay criteria:

Just to give an example on assay criteria: The maximum permitted protein content on a clean instrument must be ≤ 6.4 µg/cm^2 on every product test site. These tests are not currently designed to be routinely undertaken in dental practice. At present the practical definition for determining clean instruments in general dental practice is by visual examination of instruments under illuminated magnification.

Manufacturer recommendations indicate the appropriate cleaning process for the instrument in question and should always be followed. The preferred method of cleaning is using an automated washer disinfector that has been validated.

Validation is a documented process for the retrieval, recording and interpretation of required results. This ensures the consistent performance result of a product that complies with prescribed specifications. Thermal washer disinfectors (or automated washer disinfectors or AWD) are validated by means of a series of specific testing schedules.

If an **AWD** is unavailable, then a combination of cleaning with ultrasonic baths and manual cleaning may be an alternative process, but is impossible to validate.

Before using an ultrasonic cleaner, please refer to the manufacturer manual of your device/instrument. Ultrasonic cleaners are an inexpensive and effective means of cleaning instruments in preparation for sterilization. The mechanism of an ultrasonic is that sound waves create small bubbles that are densely distributed in the ultrasonic solution. When the bubbles implode, they create cavitation within the chamber and this activity dislodges debris from the instruments (1). A variety of solutions are available for use in ultrasonic cleaners. Plain water alone is not as effective in the cleaning of instruments as the use of a cleaning agent (1). Failure to change the ultrasonic bath water frequently (follow the manufacturers' instruction of use) allows the formation of contaminants. This will increase detectable protein residues on instruments. Instruments should be rinsed after the ultrasonic bath to remove possible contaminants.

Protein residues before and after cleaning on various types of dental instruments:

The summary by M. Vassey et al (2) on the calculation of protein residues before and after cleaning contains very interesting results. This summary looks at processing by means of manual, ultrasonic-based and automated cleaning methods.

Before each cleaning method, different protein loads were found on various types of dental instruments:

The average quantity of protein residues found on non-cleaned instruments ranged from 0.4 µg (bur made from stainless steel) to 462 µg (extraction forceps).

In terms of cleaning performance, i.e. the reduction of the respective protein load of the different instruments, the thermal washer disinfector achieved the largest reductions. The cleaning performance recorded for the contaminated instruments yielded a protein load of at least 0.4 µg and no more than 50 µg. These results provide evidence that both manual and mechanical cleaning substantially reduces the protein load of instruments contaminated to different extents. Please refer to the publication by M. Vassey et al, which provides detailed data on different instruments, from steel burs through to extraction forceps.

Important with regard to the reprocessing of surgical instruments:

To avoid stubborn surface-drying of protein residues, these instruments can be kept damp in preparation for forthcoming cleaning. In the event of contamination with blood, instruments should not be cleaned with alcohol because this fixes protein residues more firmly in place and makes cleaning more difficult.

The soaking of instruments contaminated in this way also results in protein residues bonding more strongly to the instrument, thereby rendering the subsequent cleaning more difficult. (3)

Bibliography:

(1) Bettner MD, Beiswanger MA, Miller CH, et al. Effect of ultrasonic cleaning on microorganisms. Am J Dent. 1998;11(4): 185-188.

(2) M. Vassey. A quantitative assessment of residual protein levels on dental instruments reprocessed by manual, ultrasonic and automated cleaning methods. British dental journal official journal of the British Dental Association: BDJ online · March 2011

(3) Costa DM, Lopes LKO, Hu H, Tipple AFV, Vickery K. Alcohol fixation of bacteria to surgical instruments increases cleaning difficulty and may contribute to sterilization inefficacy. Am J Infect Control. 2017 Aug 1;45(8):e81-e86.

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Short notes on
Transmission of infection

Prof AJ Smith

Background

How do infections occur?
An infection occurs when micro-organisms enter the body, increase in number, and cause a reaction of the body. **Three things are necessary for an infection to occur:**

- Reservoir: Places where infectious agents live (e.g., sinks, surfaces, human skin)
- Susceptible Person with a way for micro-organisms to enter the body
- Transmission: a way micro-organisms are moved to the susceptible person

In healthcare settings, transmission of microbes depends on people, the environment and/or medical devices.

Transmission

The common mechanisms of transmission in healthcare settings, including dental practice are;

Through contaminated hands or gloves for example, **Methacillin-resistant Staphylococcus aureus (MRSA)** contamination on surfaces can be transmitted to patients or other staff via hands. Even whilst wearing latex gloves it is important that these are changed between patients. Many Gram positive bacteria such as MRSA can survive for months on dry surfaces. It has been reported that strains of Staphylococcus aureus can survive on dry surfaces for time periods between 7 days to 7 months (3). Review articles have also noted that bacteria survive on surfaces for longer if there are higher numbers of bacteria and the presence of proteins included as such as serum, sputum or dust (5). Similar MRSA strains were recovered in patients

and dental surgery samples after attending a dental clinic (4) indicating transmission from clinic surfaces. Strains of Staphylococcus aureus can be recovered from the surfaces of portable electronic devices such as computers and ipads (Khan et al AJIC 2015). Little work has been undertaken investigating recovery of respiratory tract viruses from dental surfaces, although there has been an investigation of the immune response in dentists to assess their exposure to respiratory virus infections (Davies et al BDJ 1994 176: 262-5) that showed general dental practitioners had significantly raised antibody titres compared to controls for influenza A, B and respiratory syncytial virus.

1

Sprays or splashes from dental aerosols, can spread upper respiratory tract viruses, such as influenza. Large contaminated droplets can contaminate surfaces and transmission via hands. Influenza A and B can survive on steel and plastic surfaces for 24–48 hours and cloth, paper and tissues for <8-12 hours (Bean et al. J Infect Dis 2002). Transmission can occur for influenza viruses to steel to hands over a 24 hour period and the virus can survive for approximately 5 minutes on the hands (1). Smaller aerosolised particles can be inhaled or contaminate eyes to cause infection. Attention must also be paid to following manufacturer's instructions on the disinfection of dental unit waterlines.

2

Sharp injuries can lead to transmission of infection, for example, Hepatitis B virus can be transmitted when the skin is punctured by a used needle. The risk of Hepatitis B transmission through a contaminated sharps injury from a Hepatitis B positive patient to a non-immune recipient is estimated at 30% (2). A relatively recent example of transmission of Hepatitis B through dental procedures that demonstrates its potentially high infectious nature is that associated with a portable dental clinic in the USA where three patients and two staff were infected with the Hepatitis B virus (Radcliffe et al. J Am Dent Assoc. 2013;144(10):1110-8.). The precise mode of transmission was not detected but multiple breaches in protocols were noted such as close proximity of clean and contaminated instruments, dental handpieces were not sterilized between patients and there was no written records or traceability for the processes used.

What determines the rate of transmission?

The basic reproduction ratio (R0) is a measure of the ability of a pathogen to give rise to more infections or secondary cases. The rate of transmission of a disease is determined by a number of factors in the infectious agent.

Such as, virulence (ability to cause disease) for example the pandemic influenza strains from 1918 is reported to have a higher R0 compared to other flu viruses and host factors, such as immune response (vaccines) – the influenza vaccine is predicted each year to try and match against circulating flu viruses each year. Therefore, the efficacy of the virus can vary from season to season. Nevertheless, it is essential that dental healthcare workers get vaccinated against circulating flu viruses each year to protect themselves and vulnerable patients they maybe treating.

If the R0 is greater than 1 then the infection has potential to spread through a susceptible population. The higher the number the higher the rate of transmission. For measles, R0 is often cited to be 12–18, which means that each person with measles would, on average, infect 12–18 other people in a totally susceptible population. The **R0** for novel **influenza** A (H1N1) has recently been estimated to be between 1.4 and 1.6. It has been estimated the basic reproduction number, R0 to be 1.53 for Hepatitis B (in New Zealand), and shown that the vaccination campaign against Hepatitis B has substantially reduced this below one. R0 estimates for community strains of MRSA (USA 300) the R0 ranged from 1.24 to 1.34.

Protection against transmission

The most practical method to prevent cross-transmission in dental practice is to adhere to standard infection control precautions for all patients as it is difficult to determine which microorganisms patients maybe carrying. It is also vital that all dental staff have received the recommend vaccines and that these are kept up to date and recorded in the practice record management system.

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(2) Mann J, Roberts M. Modelling the epidemiology of hepatitis B in New Zealand. J Theor Biol. 2011 Jan 21;269(1):266-72.

(3) Prosperi M et al., Molecular Epidemiology of Community-Associated Methicillin-resistant Staphylococcus aureus in the genomic era: a Cross-Sectional Study. Sci Rep 2013; 3, 1902

(4) Kurita et al. Nosocomial transmission of MRSA via the surfaces of the dental operatory. BDJ 2006

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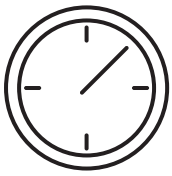
The Concept of **Sinner's Circle**

Whether performed mechanically or manually, the cleaning of used medical instruments is an important step. The general principle of cleaning, based on physical factors, was summarized by Herbert Sinner in 1959 in a simplified way in the so-called **Sinner's Circle**. Herbert Sinner was an employee of Henkel and his task was to find better methods to clean clothes and develop the respective detergents. The process itself support the removement of soluble residuals on medical devices. It is important to remember that even an optimised Sinners Circle will not remove dental cement or liners that have set on dental instruments, these must be removed at chairside.

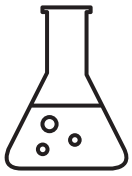
The concept of Sinner's Circle essentially makes use of **four main physical factors that affect one another:**

1



TIME
(exposure time of the other three factors)

2



CHEMICAL
(usually a cleaning solution)

3

MECHANICAL POWER
(e.g. scrubbing to remove visible dirt or to establish contact with the cleaning solution)

4

TEMPERATURE
(affects e.g. the effectiveness of the cleaning solution)

These factors are always in a specific proportion to one another and influence each other. The respective proportions of these four factors can thus be depicted as a pie chart, and the quantity of each factor can be shifted within the circle in specific proportion to the others. Also added to this is the fundamental element of water, which supports the four factors in their basic function. If the quantity of one of the factors changes, this in turn affects the other factors, but they must always fit within the circle. Detergents are still being developed at Henkel today based on his Sinner's Circle model.

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Drying – Reason why

At first glance, the importance of drying seems difficult to understand why it is mentioned in the **decontamination** cycle. This stage was initially identified in large sterilization departments, as it was found that it could lead to wet packs of surgical instrument trays. In todays modern dental surgery it is an important quality control measure as visible droplets of water remaining on/in instruments may lead to wet packs that no longer maintain their sterile barrier function (1). Water drops inside lumens may block penetration of steam. In addition, soaking wet instruments are more difficult to determine if they are clean. In some areas, if hard water is not rinsed off with purified water and then dried, limescale deposits may also appear. By drying instruments deposits and limescale deposits will be avoided, which in addition prolong the life span of the instruments.

Recommendations for correct drying

(please always follow the manufacturer's instructions)

The procedure used for drying should not only be quick and reliable, it should also prevent fresh contamination with chemical, microbial and particulate elements. **Ideally,** drying should be performed as part of the **automated cycle** in a **washer disinfector.** This is usually accomplished at the end of the thermal disinfect stage where the heat from the instruments can be used to 'flash off" any residual water. This is often assisted by a fan in the washer. Failing this, then drying shall be accomplished manually as quickly as possible after washing (see manual drying below).

Manual drying

Instruments should be dried by hand with a clean, lint-free cloth. Instrument cavities should be dried by means of compressed air, using the pressure specified by the device manufacturer. To avoid staining, metal instruments should be dried after they have been washed.

Literature:
(1) Debabrata Basu; Journal of Infection and Public Health Volume 10, Issue 2, March–April 2017, Pages 235-239