E-BOOK

BIOSAFETY AND DISINFECTION OF IMPRESSION MATERIALS FOR PROFESSIONALS IN PROSTHETIC DENTISTRY

(Lab Technicians and Dental Surgeons)

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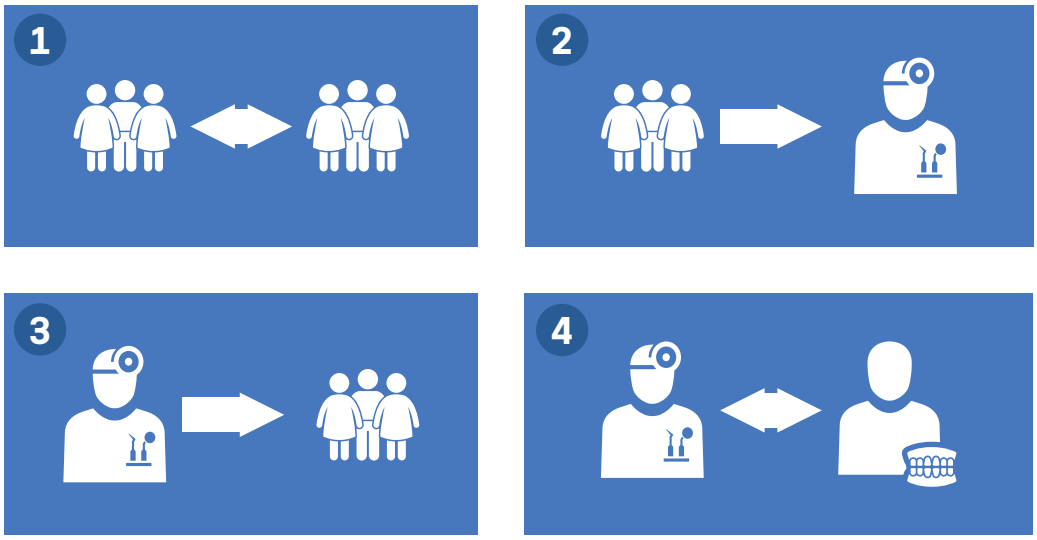
1. Introduction

Just as every patient who enters a dental clinic should always be treated as an individual carrying any given infection, despite not showing signs or symptoms of a particular disease, the receipt of impressions, bite registrations, models, components, among others, by the Dental Lab Technician team should be treated as if these materials have not been properly disinfected by the Dentists. Although the Dental Surgeon (DS) is responsible for the disinfection procedure, further care should be taken by the prosthetic team.

Biosafety can never be overlooked in dental practice, and cross-infection must always be controlled in order to keep biological risks to a minimum. Methods of disinfection and sterilization of equipment, instruments and dental materials are necessary to prevent the spread of pathogens:



1. between patients;
2. from the patient to professionals;
3. from the professional to the patient, and
4. between professionals, especially in the clinical/laboratory setting.

Just as care with instruments and equipment is important, it is also necessary to control the cleaning and disinfection of impressions that are sent to laboratories, as well as work that comes from the laboratories, as these will be tested clinically and will return to the laboratory. Cross-contamination should therefore be assessed and avoided at each stage.

Despite the importance of this matter, a study with questionnaires to DSs and Dental Technicians (DT)[1] revealed that compliance with good practices is lower than ideal, and therefore the education of dentists and technicians in relation to the problem is necessary. Another study [2] assessed the level of bacterial contamination in dental prostheses sent from the laboratory to the clinic of a Dental school and found significant bacterial contamination, mainly in the transitional processes of the final prosthesis construction. It was concluded that, during the production phases (coming from and returning to the laboratory), all prostheses represent a major potential for cross-contamination.

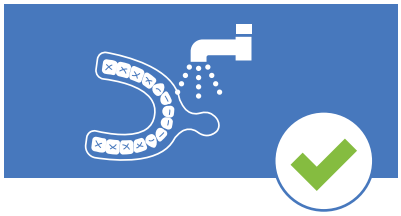
Ideally, each professional should disinfect and/or sanitize the material that they are going to deliver to another professional. That is, the DS sanitizes the materials from consultations with patients before sending to the DT. Meanwhile, the DT sanitizes the parts produced and packages them carefully in protective containers before sending their work to the DS.

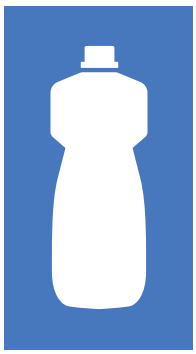
Step-by-step Cleaning

2. Step-by-step cleaning

The process of cleaning dental materials involves:

1. The removal of all organic material from the surface of the object (blood, saliva, etc.). Impression should be washed with running water, and no air or steam may be used for drying, as this results in the generation of aerosols and biological risk. The water must be allowed to drain in the same place as the running water.





2. Disinfection is the removal of pathogenic microorganisms from objects. This procedure varies from material to material, in addition to the immersion time in contact with different liquids. Addition and condensation silicones can be immersed in disinfectants. Alginates and polyether cannot be immersed, but can be dipped quickly, or the disinfectant agent can be sprayed, keeping the impression closed in a plastic bag for 10 min. Then, rinse again under running water.

Materials	Immersion	Spray & Store
Addition and condensation silicones	✔	✔
Alginate and polyether	✖	✔

Disinfection is a process that eliminates many pathogenic microorganisms from inanimate objects (with the exception of sporulated bacteria).

Sterilization is the complete elimination of all microorganisms, including spores.

The process of disinfecting impressions or prostheses requires knowledge about the effectiveness of the disinfectant product of choice and whether it can cause any dimensional change in the prosthesis material or the impression material, and/or in the plaster model. Some studies have accordingly evaluated potential changes in the impression material or in the generated model [3], while others analyzed this and the effectiveness of different methods [4]. Disinfection may be divided into three categories according to the level of efficacy:

1. High-level disinfection involves the inactivity of most pathogenic microorganisms.
2. The intermediate level involves the destruction of microorganisms such as tuberculosis bacillus, but is not capable of killing or inactivating spores.
3. The low level yields low antimicrobial activity.

Disinfection levels and molding materials[5]

Type of Disinfection	Disinfectant	Molding Material	Exposure Time
High level	+ Glutaraldehyde (2%)	Zinc enolic paste	Spray and store for 10 min or soak for 10 min
		Polysulfides	
		Silicones	
		Alginate and polyether	Spray and store for 10 min.
Intermediate level	+ Sodium hypochlorite (0.5% or 200-5000PPM) + Iodoforms (1-2%) + Phenols (1-3%) + Chlorhexidine (2-4%) + Alcohol (70%)	Zinc enolic paste	Spray and store for 10 min or soak for 10 min
		Polysulfides	
		Silicones	
		Alginate and polyether	Spray and store for 10 min.
Low Level	+ quaternary ammonia + simple phenolic detergents	Zinc enolic paste	Spray and store for 10 min or soak for 10 min
		Polysulfides	
		Silicones	
		Alginate and polyether	Spray and store for 10 min.

Different disinfection techniques

3. Different disinfection techniques:

3.1. Glutaraldehyde

Contraindicated, as it presents multiple risks to the user. However, it is capable of producing high-level disinfection with a wide spectrum and rapid-action mechanisms, also known as a "chemical sterilizer". It can destroy all types of microorganisms (including bacteria and sporulated fungi, tuberculosis bacillus and viruses) if used in the correct concentration and form[5]. It is a colored liquid of strong odor that presents some risks to users. Although it is considered the best disinfectant for cold sterilization, it is banned in some countries because it is not biodegradable. May cause irritation to eyes, skin and respiratory tract. It must be handled only in closed containers, in an environment with an exhaust unit or good ventilation while keeping the solution at a low temperature to reduce the concentration of the product in the air. Handle with nitrile gloves.

3.2. Sodium hypochlorite;

Yields intermediate-level disinfection and has a wide spectrum of antimicrobial activity. A highly used disinfectant with advantages such as: Fast antimicrobial activity, easy to use, water soluble, relatively stable, non-toxic at the indicated concentration, low cost, does not stain materials, non-flammable and colorless. Disadvantages include the fact that it irritates mucous membranes, is less efficient in an organic environment, and its corrosive effect on metals[5]. Because its mechanism of action occurs via oxidation, it is highly effective against the COVID-19 virus.

Study evaluated the effect of this product at a concentration of 1%, sprayed on alginate impressions, previously washed in running water and dried, and did not find severe dimensional changes or roughness in the models obtained from these impressions[6]. However, the literature describes small dimensional changes when using impression immersed for 15 minutes in a solution with 0.5% concentration[7].

3.3. Iodoform

Low to intermediate level of disinfection, being bactericidal, mycobactericidal and virucidal. It is also a fungicide, but requires more contact time for action. Better used as an antiseptic than

as a disinfectant. It is not sporicidal, it can cause stains, it is not flammable, and it has an irritating effect on membranes and mucous membranes. Organic materials left on the surface may lead to neutralization of the disinfecting ability of iodine, so an increased contact of the disinfectant is required to complete disinfection[5]. According to one study, 30 minutes of exposure to povidine-iodine (0.1%) did not cause significant distortions in polysulfite or polyvinyl siloxane material impressions[8].

3.4. Alcohol

They provide an intermediate level of disinfection, with 70% ethyl and isopropyl alcohol. Isopropyl alcohol is commonly used as an antiseptic. Office surfaces can also be disinfected with 70% isopropyl alcohol. Ethyl alcohol is more potent in bactericidal than in bacteriostatic activity. It also acts on bacillus of tuberculosis, fungi and viruses. They are not indicated as a impression disinfectant because they can cause changes in the surfaces of the impressions. They are also not indicated for disinfection of acrylic prosthesis bases[5].

3.5. Phenols

They are classified under an intermediate level of disinfection. Also known as protoplasmic poisons. In low concentrations, they promote lysis of growing *e.coli, staphylococcus,* and *streptococcus bacteria*. They have antifungal and antiviral properties. Used in mouth wash, soaps and surface cleaning. Not indicated for disinfection of impressions. They are incompatible with latex, acrylic and rubber[5].

3.6. Chlorhexidine

Intermediate level disinfectant and antiseptic. It has a wide spectrum of activity and is also used as an anti-putrid substance. It is commonly used in oral rinsing and soaps. It is bactericidal, virucidal and mycobacteriostatic. Its activity decreases in the presence of organic material, since it is dependent on pH. Study finds that it can be used at a concentration of 0.2% by replacing water to prepare alginate. The impression can also be immersed in chlorhexidine and provide effective disinfection[9]. It is also considered to be a product indicated for disinfection of prostheses containing metallic components, during trips back and forth between the clinic and the laboratory,

which are characteristic of the laboratory process (since sodium hypochlorite would not be indicated due to the presence of metal)[2], [5].

3.7. Ionized water

Ozone (O_3) is an inorganic gas molecule, has antimicrobial, anti-hypoxic, analgesic and immuno-stimulatory activity. It is used for the disinfection of water, oral cavities and dentures. Ozonated water can be used to disinfect impressions. Study shows good disinfection results using ionized water produced by a specific machine in impressions contaminated with P. aeruginosa, S. aureus and C. albicans. The authors also find that ionized water is more biocompatible than sodium hypochlorite, chlorhexidine or oxygenated water, and can be used with immersions for longer to achieve more effective disinfections[10].

3.8. Peracetic Acid

It has biochemical advantages that allow its high-level use in the medical field[11], [12]. Characteristics of peracetic acid such as favorable pH, good antimicrobial capability, and low toxicity suggest properties for disinfection of impressions in the dental routine. It is used in a 1% proportion in the disinfection of impressions and its anti-microbiological capability has been proven in a microbiological study[13], but dimensional stability studies have not been found.

3.9. Other methods described

Sterilization of impressions or plaster models using microwave irradiation is also considered. These cause changes in the integrity of the cell membrane and cell metabolism that lead to microbial death. It is considered a simple, low cost and effective method of disinfection. Indicated for disinfection of full prostheses and also for impressions[5]. Study[14] shows the effectiveness of this method when combined with hydrogen peroxide, without causing material changes.

The use of ultra-violet radiation is also described and defended by a study by Nimonkar et al. [15] who compared this method with chemical disinfection using 1% sodium hypochlorite and 2% glutaraldehyde in relation to the stability of polyvinyl siloxane.

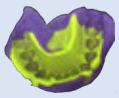
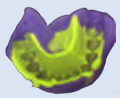
WORKFLOWS

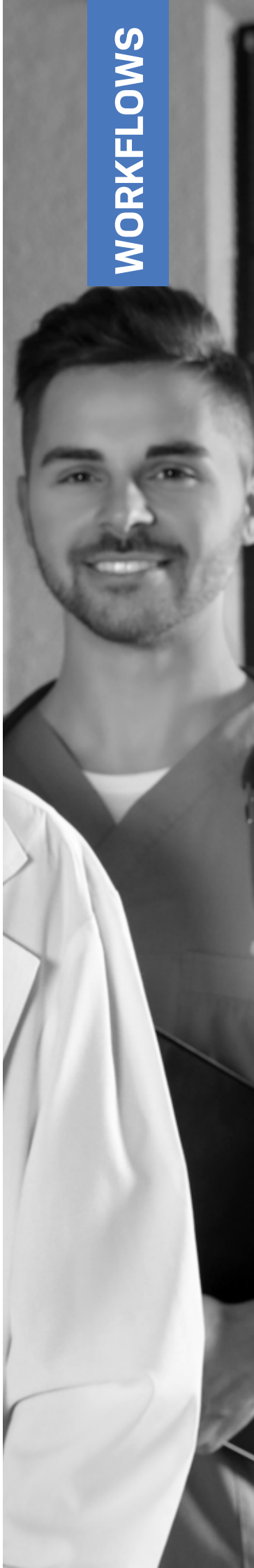
Prosthetic workflows and biosafety

4. Prosthetic workflows and biosafety:

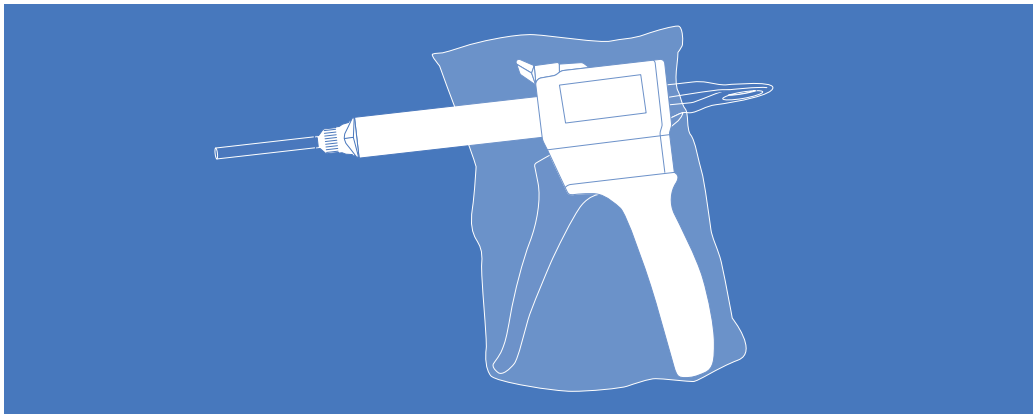
Dentistry currently has different workflows, one that is "traditional" or "conventional", done via impression processes, impression materials, and the manufacture of plaster models, as well as others that are "digital" and can be: partially digitized (with scanning of plaster models) or totally digital using intra-oral scanning and printing of dental models.

4.1. Summary of materials used by DSs and DTs according to the prosthetic workflow:

	CONVENTIONAL **WORKFLOW**	SEMI-DIGITAL **WORKFLOW**	FULLY DIGITAL **WORKFLOW**
PORTFOLIO USED	 Impression Trays	 Impression Trays	 *Intra-oral* Scanner (IO)
	 Impression Material	 Impression Material	
		 Dental Model	
		 *Model* Scanner (may be at Laboratory or Clinic)	 Laboratory Mill, *Chairside* Mill, and 3D Laboratory printer
	 Dental Model	 Laboratory Mill, *Chairside* Mill, and 3D Laboratory printer	



The entire impression process results in clinical contact with the patient and potential biological hazards, especially when impressions or plaster models are transported from one location to another. Even impression guns require protection to prevent possible infections, procedures such as surface disinfection with chemical/liquid agents, plastic barriers, and even sterilization (131º C, 10 min) are suggested by the literature[16].



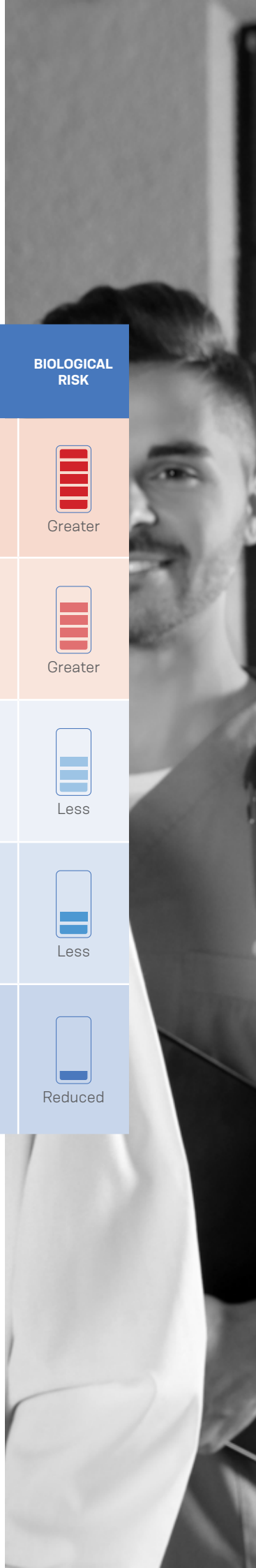
Impression guns should be protected against possible microbiological agents.

As previously mentioned, each prosthetic step in which a work is physically transported from a clinic to a laboratory, and vice versa, can result in cross-contamination[2]. Droplets and aerosols from dental environments are a great biological risk, mainly because it is known that there are viruses that can remain infectious on wet surfaces for between 2 hours and 9 days[17].

Why conventional impression making procedures have more biological risks when compared to IO scanning, where images are transferred from one environment to another via Internet data packet and the imaging process is accurate, safe and clean. The process of disinfecting impressions is a sensitive technical procedure that has deformation risks when performed[18], [21].

4.2. Summary of the processes used by DSs and DTs according to the prosthetic workflow and its biological risk:

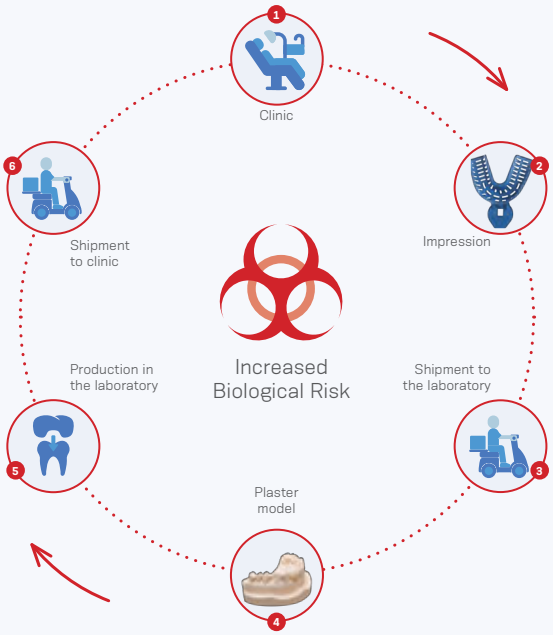
WORKFLOW	IMPRESSION	SCAN LOCATION	TRANSFER OF INTRA-ORAL DATA FROM THE CLINIC TO THE PRODUCTION SITE	FORM AND PLACE OF PRODUCTION	BIOLOGICAL RISK
Conventional	Yes	-	Transport	Conventional Laboratory	Greater
Semi-Digital (*Laboratory* Model Scanner)	Yes	Laboratory	Transport	Laboratory (3D Printing or Machining)	Greater
Semi-Digital (*Dental Office* Model Scanner)	Yes	Clinic	STL Internet	Laboratory or Clinical (3D Printing or Machining)	Less
Semi-Digital (*Dental Office* IO Scanner)	Yes	Clinic	STL Internet	Laboratory (3D Printing or Machining)	Less
Fully Digital (IO Scanner)	-	Clinic	STL Internet	Laboratory or Clinical (3D Printing or Machining)	Reduced



4.3. Different prosthetic workflows and biological risks:

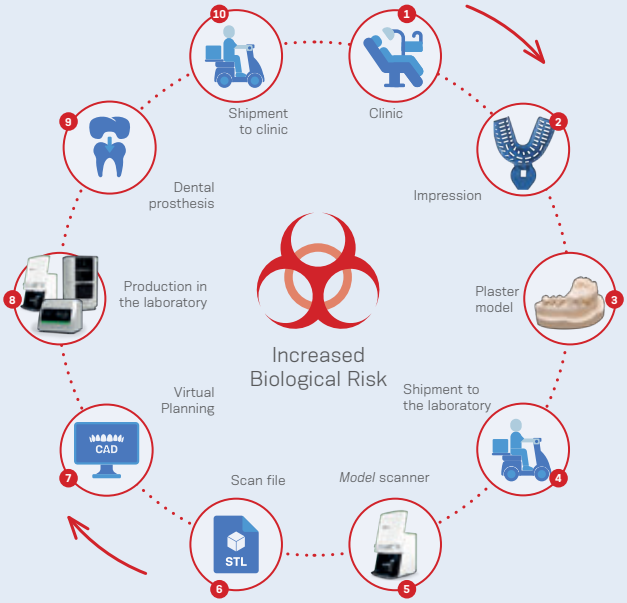
4.3.1. Conventional workflow with laboratory production

Impressions	Minimum 1
Transport	2 times
Scanning	0



4.3.2. Semi-digital workflow with laboratory production and scanning

Impressions	Minimum 1
Transport	2 times
Scanning	1



4.3.3. Semi-digital workflow with clinical scanning and laboratory production

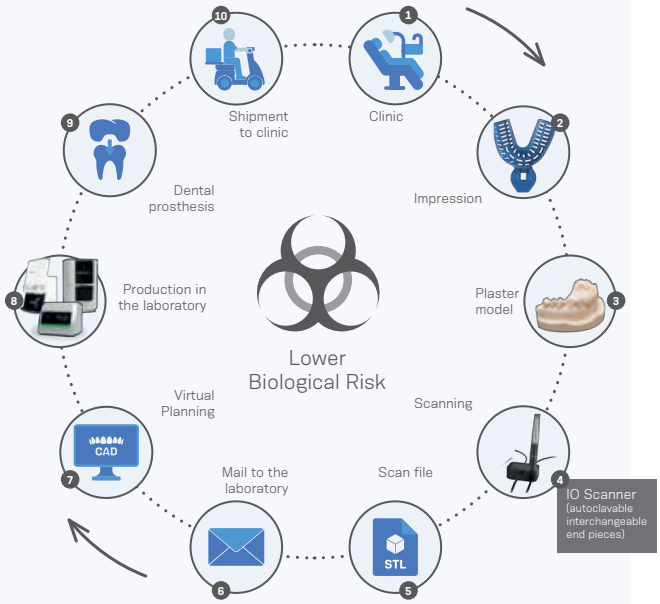
Impressions	Minimum 1
Transport	1 time
Scanning	1

4.3.4. Semi-digital workflow with clinical production and scanning

Impressions	Minimum 1
Transport	0 times
Scanning	1

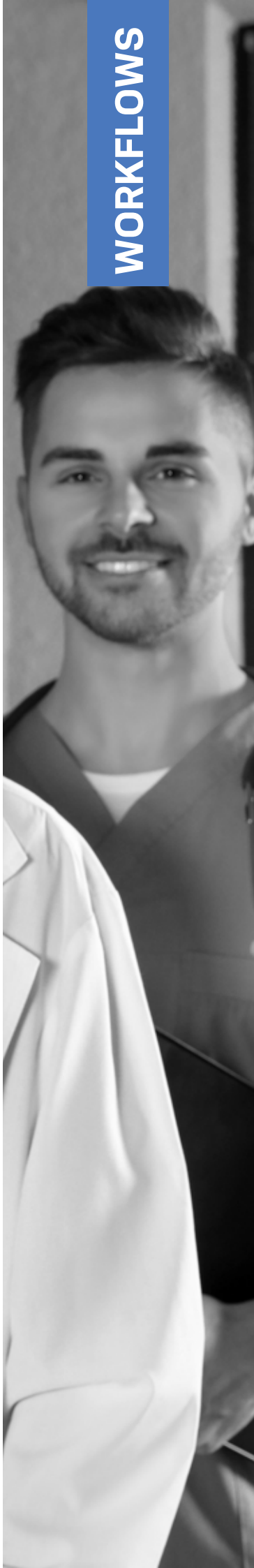
4.3.5. Semi-digital workflow with clinical scanning and laboratory production

Impressions	Minimum 1
Transport	1 time
Scanning	1



4.3.6. Digital workflow with clinical scanning and laboratory production

Impressions	0
Transport	1 time
Scanning	1



4.3.7. Fully digital workflow with clinical production

Impressions	0
Transport	0 times
Scanning	1

4.3. Different prosthetic workflows and the biological risks:

Scanning tips should also be sanitized and sterilized, and the cords should be disinfected as shown below.

Manual Cleaning of the End Pieces

Sterilization of the End Pieces

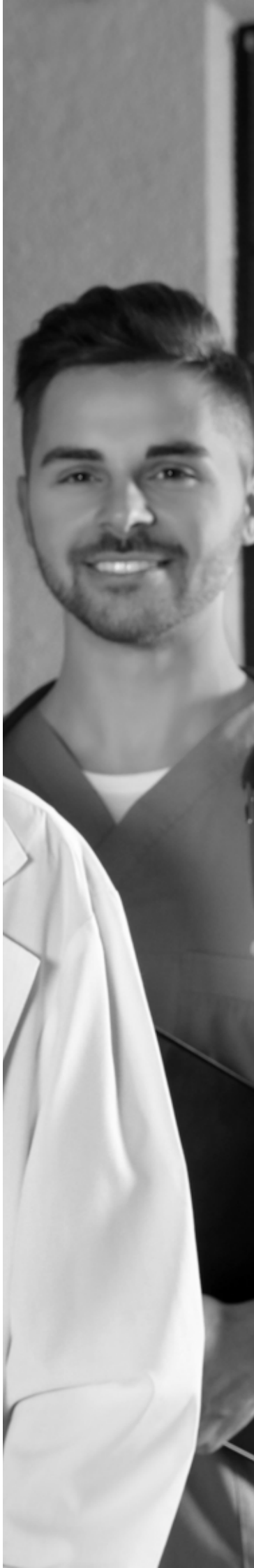
3 interchangeable tips – autoclavable up to 250 cycles

Hand Piece Disinfection

5. Conclusions

Conventional impression materials and processes pose greater biological risks, so the techniques for disinfecting impressions must be carefully performed according to the characteristics of the impression material, the chemical disinfectant agent, and the ability of the DS and/or DT.

Complete digital flow helps in controlling biosafety. Communication should be clear between the DS and the DT in terms of biosafety in order to avoid cross-contamination between professionals.



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