Gloves in dentistry - protection and ergonomic implications

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Abstract

The comprehension of the risk of doctor-patient microbial contamination has led to the use of protective gloves at the standard level of precautions. Their widespread use has required increased attention to different types of gloves and their correct use. This article is an overview of the main types of gloves and the implications of their use in daily practice. Considering the attributes of the gloves used by dental practitioners, we presented and detailed three major aspects: the level of protection offered by gloves as a physical barrier, the ergonomic aspects of their use and the risk of complications associated with their use. Finally, it is important to choose the right type of gloves in accordance to criteria related to the medical procedure and the aseptic conditions required, the estimated duration of the procedure, the various dental materials used, as well as in accordance to the possible irritations or allergies caused by wearing gloves.

Keywords: latex, synthetic materials, resistance, ergonomics

INTRODUCTION

The necessity of using gloves in dental practice is generated by the risk of microbial dentist's contamination from de patient or vice versa. There are two main ways that can generate the doctor's contamination in the dental office: the airways, through micro-drops and aerosols generated during the medical procedures and the skin, through direct or indirect contact. Direct contact implies touching the patient's teeth and/or soft tissues, microbiologically loaded, by the doctor. Saliva, blood and other secretions from the oral cavity carry possible pathogens. Possible lesions of the skin on the hands and the space around the nails allow, in the absence of gloves, the microbial contamination of the doctor's hands with germs from the patient. Indirect contact is the contact of the hands of the operator with contaminated instruments, equipment, surfaces or hands during the medical procedures or the accidental injury with sharp contaminated instruments [1]. Without glove's protection, both direct and indirect contacts expose the doctor and the rest of the medical staff to possible illnesses.

The use of gloves in the dental office began to increase in the mid-1980s, as a response to the HIV epidemics, to the risk of infection with hepatitis B virus, and to other blood-borne pathogens. During the same period, the concept of "universal precautions" appeared, according to which the blood and certain body fluids of all patients are considered potentially infectious (HIV, HBV, etc.). Universal precautions are aimed at limiting the exposure of mucous membranes and skin with lesions, possible routes of infection [1].

In 1996 the CDC (Centers for Disease Control and Prevention) expanded the concept of universal precautions and adopted a new term - "standard precautions". These new standard precautions are designed to protect dental practitioners against all pathogens, not just blood-borne ones. They take into consideration the risk of exposure to all bodily fluids, secretions and excretions (sweat except only), so that saliva is also considered a potentially infectious secretion [1]. The 2003 CDC provides detailed recommendations for proper hand hygiene and the wearing of different types of gloves [2].

Aim and objectives

We approached the subject of gloves in dental practice mainly because of their major role in the protection of medical staff and patients but also due to the very diverse offer on the market, which can often make one's choice a difficult task. Outlining the specific characteristics, advantages and disadvantages of different types of gloves, as well as their indications in accordance to the therapeutic act, helps the medical staff use the gloves properly.

Considering the attributes of the protective gloves used by dental practitioners, we identified three major aspects to discuss: the level of protection offered as a physical barrier, the ergonomic aspects of their use and the complications associated with use.

MATERIAL AND METHODS

LEVEL OF GLOVES' PROTECTION AS A PHYSICAL BARRIER

The level of protection offered by gloves depends on their ability to function effectively as a physical barrier between the hand and possible contaminants on various surfaces and tissues. The physical characteristics of the gloves, as well as a number of other aspects of their use influence the degree of protection offered.

Physical characteristics of gloves

The physical characteristics of the gloves depend on the qualities of the material from which they are made and on the manufacturing process. The following materials are most often used for gloves used by doctors:

1. latex (NRL - natural rubber latex),
2. nitrile (synthetic material, nitrile - acrylonitrile-butadiene),
3. vinyl (synthetic material, vinyl or PVC - polyvinyl chloride),
4. neoprene (synthetic material, polychloroprene) [3,4].

Durability or resistance to puncture and wear is often considered in relation to the material the gloves are made of. A number of studies show differences in this regard and thus guide our choice. Latex was the reference value (the excellence value) for durability, but currently nitrile is also considered to have excellent durability. Vinyl is limited in this regard, being less resistant to perforation and wear [3,4].

The elasticity and flexibility of the material are especially significant characteristics because they influence the dexterity of the doctor and the fineness control of the instrumentation [3,4]. By wearing gloves, the doctor's tactile sensitivity decreases significantly, but not as much as to affect the quality of the therapeutic procedures and it can be recovered through exercise [5]. The elasticity and flexibility of latex are superior to the elasticity and flexibility of nitrile (which is more rigid), whereas vinyl has low elasticity and flexibility [3,4].

During the clinical procedures performed by dentists, gloved hands come into contact with various chemicals (antiseptics, composite resins, adhesives, etc.) that can affect the integrity of the glove. Latex and nitrile have a good resistance in relation to different chemicals, but vinyl is less resistant. Beware, however, latex is sensitive to several chemical products and can be degraded by petroleum-containing materials [3,4]. It should also be noted that latex interferes with the setting of addition impression materials (vinyl polysiloxane), fact that has not yet been proven for gloves made of synthetic materials [2].

Neoprene gloves are considered to be comfortable (elastic and flexible) and provide good protection (durability), but they are significantly more expensive than other types of gloves. They are the most effective barrier in relation to the dental materials containing methacrylate [4].

The quality of gloves made of various materials also depends on the correct monitoring and rigorous control of the manufacturing process, a complex process with many stages. The manufacture of gloves basically consists in the immersion of glove formers in a solution or emulsion, followed by a series of other procedures up to the final conformation and detachment of the gloves from the formers. All stages must be well controlled by the manufacturer in order to obtain good quality gloves with optimal properties [3].

Medical gloves are available in powdered or non-powdered versions. The powdered variants have powder (corn starch), in variable quantities on both surfaces of the gloves - inner and outer. Obtaining non-powdered variants requires additional interventions in the manufacturing process [3,4]. The presence of powder creates a number of problems in practice. Thus, when applying and removing powdered gloves, the powder is released into the air, which can lead to respiratory complications. On the other hand, contact of the powder with the doctor's skin involves an increased risk of microbial multiplication on the doctor's skin, irritation, allergies and poor healing of skin lesions. During surgery or periodontal surgery, the powder on the surface of the gloves can reach wounds, favoring microbial multiplication and causing poor healing [3]. Thus, preventive recommendations include the use of non-powdered or only slightly powdered gloves and the avoidance of excessive tension and stretching of powdered gloves, thus limiting the release of powder into the air [3].

The protection offered by gloves depends, in addition to physical characteristics, on other aspects.

The correct choice of gloves in accordance to the medical procedure

Depending on the type of care provided, medical gloves can be gloves for examination and treatment or sterile (surgical) gloves. Both types can be made of latex or synthetic

materials [5]. Surgical gloves must meet standards that guarantee "sterile" character and thus provide maximum safety in protecting wounds from microbial contamination [2].

Hand hygiene and accessories

Wearing gloves does not eliminate the need to wash the hands with an antibacterial soap, which must be done just before applying the gloves and immediately after removing them. The motivation for this need is given by the fact that the gloves may have small imperceptible defects or may be perforated during use which would expose the patient and the surgical wound to contamination. These small defects also expose the doctor's hands. Another motivation for the need to wash hands before and after wearing gloves is the fact that under gloves, in the humid environment, the microorganisms on the surface of the hands can multiply considerably. Thus, it is recommended that washed hands are well dried before applying gloves [2]. There are authors who appreciate that when the hands are visibly clean it is sufficient to disinfect them with an alcohol-based hand sanitizer solution or gel [2,4]. Some studies highlight a misconception of some practitioners that the use of gloves would replace the need for hand hygiene and ensure the guarantee of protection. This concept corresponds to a false sense of protection offered by gloves [4].

The integrity of the skin is itself the most important barrier against medical contamination in relation to the patient and to the work environment and therefore maximum attention must be paid to the health of the skin. [4]. If the clinician has scratches or injuries on fingers or palms, they will first be covered and protected with a patch [2].

Regarding natural nails, they should be cut short because most of the microbial flora of the hands is under and around the nails. Their length must be reduced so as to allow rigorous hygiene and not to strain the gloves, predisposing them to perforations; their edges must be smooth, and if a varnish is applied it must be intact, unblemished. Artificial nails in any form are not indicated when wearing gloves because they predispose to microbial colonization and perforation of gloves [2,4].

Wearing rings under gloves is not recommended because they do not allow proper and complete hygiene of the hands, under them there are spots of microbial multiplication and in addition they can make the application of gloves difficult and can cause rapid wear or perforation of gloves [2,4].

Glove integrity and wearing time

A number of factors affect the integrity of the gloves, including the durability of the material, the wearing time, the medical procedure and the manufacturer. Various studies show a frequency between 6-16% of perforations of the gloves used by surgeons. Most often doctors are not aware of the occurring of minor defects which are difficult to perceive [2].

The wearing time of a pair of gloves affects the degree of protection they offer because the longer the wear, the greater the risk of defects (micro perforations) [4]. A number of studies show that defects occur in a time frame of 30 minutes to 3 hours [7]. Thus, it is recommended to change gloves immediately if there are visible defects or at every one hour of wear. When changing gloves, respectively before applying the new pair of gloves, hands should be washed again or at least disinfected with an alcohol-based disinfectant solution or gel [2,4,5].

During dental therapeutic operations, doctors' gloves also come into contact with multiple chemicals - antiseptic solutions, composite resins, adhesives, etc. - which can affect their integrity [2].

Washing latex gloves with soap, clohexidine-based solutions or alcohol may cause liquid to penetrate through pre-existing minor defects or may cause micro-perforations that predispose to hand contamination and it is, therefore, not recommended [2,4]. After disinfecting the hands with alcohol-based solutions or gels, before applying the gloves, the hands must be thoroughly dried because the remaining alcohol can also affect the integrity of

the gloves [2]. If the practitioner wants to reduce the amount of powder on the surface of the gloves it can be rinsed with plain water [4].

Using two pairs of overlapping gloves

The effectiveness of wearing two pairs of overlapping gloves has not been demonstrated, but studies have shown lower contamination and fewer defects of the inner gloves, fact that suggests increased protection for the operator's hands [1,2]. Thus, wearing two overlapping gloves would provide additional protection, but it must be evaluated in relation to the impairment of tactile sensitivity and manual dexterity, aspects of particular importance to the dentist who performs very fine therapeutic acts and uses small instruments.

ERGONOMIC ASPECTS OF GLOVES USE

The dental practice is of surgical precision and it uses very fine instruments, which require a very good control and maximum coordination of the movements during work. Dental practice specific movements are, besides being highly precise, repetitive and of little amplitude. All the structures in the oral cavity are small and often difficult to access. The gloves come between the doctor's hand and the instrument used, so their impact in practice can be significant. From an ergonomic point of view, gloves are especially important because the doctor's interaction with them is intimate, frequent and long lasting. They must offer, in addition to protection, the guarantee of a safe and efficient grip of the tools and optimal handling. Thus, gloves should not limit or hinder the doctor's movements during therapeutic procedures, this depending on a number of characteristics of the gloves.

Characteristics of gloves that influence grip and dexterity:

a) elasticity of the material the gloves are made of – this has been discussed in the presentation of the materials.
b) the conformation of the gloves, they can be ambidextrous or right-left conformed. This aspect can have implications on the posture of the thumb during work, in the sense that the right-left conformed gloves are favorable to the neutral posture of the thumb and offer more comfort and better handling. Ambidextrous gloves are less adapted to the shape of the operator's hands, which implies premature fatigue and a possible limitation of blood circulation. These are usually satisfactory for examination and short interventions, but for long, complex interventions, including surgical ones, right-left conformed gloves are preferable [4]. In general, ambidextrous gloves are packed in boxes with a large number of pieces and are not sterilized. Right-left conformed gloves are usually sterile gloves, packed in pairs and arranged so that the outer surface is not touched and therefore contaminated when the gloves are applied. These are also the most suitable for long, laborious and very fine work (surgery and implantology, endodontics, periodontology). Figure 1 illustrates a pair of right-left conformed neoprene surgical gloves.
c) the correct choice of size. Gloves must be intimately adapted to the doctor's hands. When they are too small, the gloves will be excessively tensed, which implies a higher risk of premature wear and limitation of the doctor's movements, generating discomfort and muscle tension. If the gloves are too large, the excess material, highlighted on both the fingers and the palm, could be bent, hung and even torn during the handling of the instrument. In addition, oversized gloves can affect the quality of the instrument grip and handling [4,5].
d) the superficial texture of the gloves and the presence of a micro relief in the area of the fingers are aspects that reduce slipping and favor the grip of the instruments [4]. Figure 2 illustrates the superficial texture of a neoprene surgical glove.

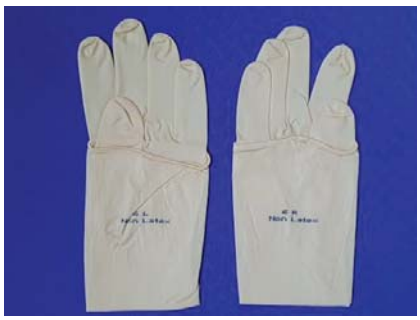

Figure 1. Surgical gloves, neopren

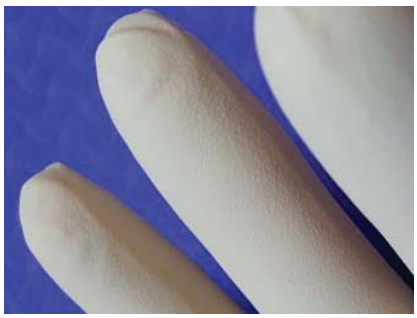

Figure 2. Superficial texture, neopren

In the gloved hand - tool - field of work relationship, each component has an impact on precision, comfort and work safety. As previously presented, the gloves influence the quality of the grip on the instruments and the control of the instruments. In daily practice, there is an interaction between the ergonomic features of the gloves and of the instruments.

The "ergonomic" instruments participate through a series of specific features to the grip. Thus the handle of the manual instruments should be designed as in to ensure optimal grip and control during work:

- an average diameter raging between 7-12 mm so that when using the modified pencil grasp the thumb, the index and the middle finger are positioned easily and there is no need to tighten the instrument;
- the material of the handle and its texture must prevent slipping of the grip fingers. In this regard, plastics and textured metal are preferred;
- in the grip area the handle should have edges, or digit form uneven nesses (concavities) that prevent the instrument from twisting and slipping.

Figure 3 illustrates the grip of an ergonomic instrument, a nitrile glove.

Figure 3. The grip of an ergonomic instrument

The hand pieces of the mechanical instruments must be designed with elements similar to those of the ergonomic handle of the manual instruments, respectively: the surface texture and relief elements in the grip area.

It should not be neglected that, in practice, the humidity of the oral environment can interfere between the gloves and the instruments used and can affect the grip and handling of instruments. Therefore, working in a dry environment, as the one ensured through the use of the rubber dam, offers significant, perceptible advantages during work.

The positioning of the gloves dispenser within reach and the easiness of getting them out of the box are also important ergonomic elements because the gloves getting process is a repetitive task, quite frequent though a day's routine.

Easy glove application is also an ergonomic factor. It depends on the correct choice of size, the conformation of the gloves (ambidextrous or right-left conformed), the patience and attention paid to the application. Properly applied gloves should come over the sleeves of the robe.

The color of the gloves in the bright light of the unit lamp or the additional light sources of loupes or operating microscope, have an impact on visibility, therefore colors contrasting with the rubber dam foil and with the oral environment are preferred. In general, the various colors of the gloves satisfy both the visual contrast and the aesthetic taste of the doctor.

COMPLICATIONS ASSOCIATED WITH THE USE OF PROTECTIVE GLOVES

Complications associated with wearing gloves are important criteria for their choice. They may be irritant or allergenic due to the material or powder.

Non-allergenic irritations are the most common complication, it being associated with latex gloves or synthetic materials and it manifests as a contact dermatitis. They are generated by the chemical components of the manufacturing material or powder and are aggravated when the gloves are too tight generating increased friction with the skin surface. Thus, these complications can be limited by carefully choosing gloves, avoiding those powdered or too small [3].

Allergenic complications can be caused by a number of chemical components used in the gloves manufacturing process (most often residual chemical accelerators in the manufacturing process generate cell-mediated type IV allergies), or by latex protein (rubber tree protein, type I allergy, mediated by antibodies) [2,3]. Latex protein is attached to the powder of the gloves and it is released through skin contact or as an aerosol that can be inhaled [7]. Latex allergy is rare, but more serious, and it ranges from allergenic dermatitis to severe anaphylactic reactions. Once manifested, it requires the avoidance of latex gloves and the use of synthetic materials [2,3]. But there are also patients with latex allergy, generally among those with multiple food allergies, situations in which gloves made of synthetic materials will be used [5,6].

A number of complications are generated by the powder itself. Avoiding them involves choosing lightly powdered or non-powdered gloves [2,3].

CONCLUSIONS

Considering the discussed issues, the choice of gloves becomes an important decision, with significant implications in dental practice. A number of selection criteria can be outlined and used in practice for choosing gloves: the type of clinical act and asepsis conditions to be followed during it, the estimated duration of the procedure, the different dental materials used and last, but not least, possible irritations or allergies caused by the manufacturing material or powder. These are added to other individual, subjective preferences, generated by personal experience with a certain type of gloves, possibly provided by a certain manufacturer. The ergonomic aspects presented emphasize once again the importance of careful gloves choice, so that they satisfy both the protection and safety need during work and the need for comfort at work.

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