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Dental Supplement | Medical Glove Selection for Dental Professionals

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Introduction

Dentistry is a hands-on profession. It is estimated that dental professionals wear medical gloves 40 or more hours per week to protect their hands from exposure to bacteria, viruses and other microorganisms via patients' blood and saliva. Specific dental-related chemicals, compounds, biocides and cleaning agents can diminish or weaken puncture resistance and glove strength, potentially compromising the safety of the wearer. Additionally, inappropriate glove selection may put the patient at risk for a variety of complications. The following review highlights critical considerations when selecting medical gloves for dental professionals.

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Physical Characteristics: Considerations for Glove Selection

Two key physical characteristics of medical gloves are barrier integrity and desired attributes.

Barrier Integrity

Gloves vary in performance reliability. Barrier integrity is impacted by the quality of the manufacturing process and base glove material.

Quality of the Manufacturing Process

Image 1. Glove formers being dipped into the liquid glove solution.

Glove manufacturing is a complex process which includes dipping of the glove formers into a liquid glove solution or emulsion, rinsing, curing, stripping the gloves from the formers and drying. Additional processing is required for powder-free gloves. Quality manufacturing is critical for the production of quality medical gloves. Therefore, the manufacturing process must be stringently monitored in order to control the physical properties of the final product. Consider requesting barrier performance data from the manufacturer prior to purchase and use of gloves.

Base Glove Materials

A key consideration when assessing barrier integrity is the material from which the glove is made. The three most frequently used base materials for examination gloves include natural rubber latex (NRL), and two synthetic materials - acrylonitrile-butadiene (nitrile), and polyvinyl chloride (vinyl, PVC). Table 1 is a summary of the physical characteristics of these three materials.

Table 1. Glove Material Comparisons

	NRL 	Nitrile 	Vinyl 
Strengths	• Benchmark for durability[1] • Highly resistant to punctures and tears[2] • Good resistance to many chemicals[†]	• Excellent durability in use[2,4] • Highly resistant to punctures and tears[5] • Effective against a wide range of chemicals[†1,6,7,8]	• Resistant to oils • Resistant to ozone
Limitations	• Petroleum-based products can degrade[1,3] • Ozone, oxygen and ultraviolet light can deteriorate[1,3]	• Usually not as flexible as NRL • Ozone, oxygen and ultraviolet light can deteriorate	• Limited durability, elasticity and tensile strength[6] • Increased potential for punctures and tears[6] • Limited use with chemicals[†9,10] • Not recommended for use with chemotherapeutic drugs, glutaraldehyde or alcohol[9,10]

[†] *Ask manufacturer for information regarding resistance to specific chemicals.*

Table 2. Medical Examination Glove Barrier Performance Studies

Author	Date	Durability Challenge (a)	Leakage Percentage Rates (b)			
			Standard Vinyl	Stretch Vinyl	Latex (NRL)	Nitrile
Kerr (c)[4]	2004	X (d) X	33.0 % 35.5 %		9.2 % 9.0 %	5.5 % 7.5 %
Kerr[11]	2002	X	35.0 %		9.0 %	
Korniewicz[12]	2002	X	8.2 %		2.2 %	1.3 %
Rego[2]	1999	X	43.5 %	16.0%	2.0 %	2.0 %

(a) Simulated use
(b) When more than one brand of a particular material was evaluated, failure rates were averaged
(c) Chloroprene was included in the original study
(d) Glove durability method (shaking gloves in an abrasive medium for 10 min)

In addition to the inherent physical characteristics of the different glove materials, both simulated and in-use studies have been performed to evaluate glove durability. Table 2 is a summary of four published barrier studies on NRL, nitrile and vinyl medical gloves over the last decade. As shown, each of these materials will differ, sometimes dramatically, in strength and durability when subjected to various stresses under different conditions.

Given this information, recommendations for appropriate glove selection have been made. For instance, in a recent update of the Guideline for Isolation Precautions, the CDC states that either NRL or nitrile gloves are preferable to vinyl for clinical procedures that require manual dexterity and/or will involve more than brief patient contact.[13]

Desired Attributes

In addition to barrier integrity, there are certain attributes that are desired by those who wear medical gloves. Commonly desired attributes include:

- Ease of removal from packaging
- Ease of donning
- Ease of movement/flexibility
- Good fit (not too tight or loose)
- Secure grip
- Tactile sensitivity

These preferences are very individual, subjective and task dependent; therefore, it is recommended that staff glove evaluations take place to assess each quality.

Image 2. Three types of base glove materials (from top): natural rubber latex (NRL), acrylonitrile-butadiene (nitrile) and polyvinyl chloride (vinyl, PVC).

Images 3,4. Commonly desired attributed of gloves include secure grip, tactile sensitivity and ease of movement/flexibility.

Associated Complications: Considerations for Glove Selection

Complications associated with medical gloves are a second consideration for selection. These complications include irritant and allergenic potential as well as powder complications.

Irritant and Allergenic Potential

Glove-Associated Irritation

Image 5. Example of Glove-Associated Irritation *(Dermatitis, Irritant Dermatitis, Irritant Contact Dermatitis).*

Irritation, the most common of the three glove-associated reactions,[14,15] is non-allergenic. It can affect any individual and may occur when wearing either NRL or synthetic gloves.[15] Glove-Associated Irritation may be caused by the presence of chemicals, and/or powder left on the glove post-manufacture.[16] Additionally, friction may cause irritation if the glove fits too tightly and rubs continuously against the skin.[15]

In order to reduce the risk of developing a Glove-Associated Irritation, select gloves that are:[17,18]

- Appropriate for the barrier protection needed
- Low in residual chemicals
- Powder-free
- Well-fitting

Glove-Associated Type IV, Chemical Allergy

Image 6. Example of Type IV, Chemical Allergy *(Chemical Allergy, Type IV Hypersensitivity, Allergic Contact Dermatitis, Delayed Type Hypersensitivity).*

A Type IV, Chemical Allergy is a T-cell-mediated allergic response to chemicals referred to as chemical contact sensitizers.[14,15,19] Chemical accelerators (e.g., thiurams, thiazoles, carbamates) have been linked to Glove-Associated Type IV, Chemical Allergies more than any other chemicals used in the manufacture of gloves.[15,19,20] Although one or more accelerators are necessary in the manufacturing of most medical gloves, the type and quantity used vary by manufacturer.

In order to reduce the risk of developing a Glove-Associated Type IV, Chemical Allergy, select gloves that are:[18]

- Appropriate for the barrier protection needed
- Low in residual chemicals
- Low in chemical contact sensitizers
- Powder-free

Glove-Associated Type I, Natural Rubber Latex Protein Allergy

Image 7. Example of Type I, Natural Rubber Latex (NRL) Protein Allergy *(Latex Allergy, Protein Allergy, Immediate Hypersensitivity, Natural Rubber Latex (NRL) Allergy).*

A Type I, NRL Protein Allergy is an IgE antibody mediated allergy to the naturally occurring proteins found in raw NRL from the rubber tree, *Hevea brasiliensis*.[19,21,22] This allergy is the least common but, potentially, the most serious of the three glove-associated reactions.[20]

To prevent a Glove-Associated Type I, NRL Protein Allergy, the goals are to prevent initial sensitization of non-sensitized persons and to prevent reactions in individuals who are NRL-sensitized. It has been noted that "The only effective prevention strategy at this time is NRL avoidance."[16]

However, if NRL gloves must be worn, select gloves that are:[18,23]

- Low in proteins [specifically NRL proteins]
- Powder-free

And, of course, if an individual is already allergic to NRL, they should avoid all products made of NRL. According to OSHA's Bloodborne Pathogens Standard, employers must provide suitable non-NRL gloves as choices for employees who are allergic to NRL. These gloves should provide the appropriate barrier protection for the task[s] to be performed.[3,16,23]

Powder Complications

In addition to the irritant and allergenic potential, powder complications have also been associated with medical gloves. A powdered glove has powder on both its inner and outer surfaces; the amount of powder will differ depending on the manufacturing process. Once in the dental environment, this powder may be disbursed by direct and indirect contact, aerosolization, and torn or perforated gloves.

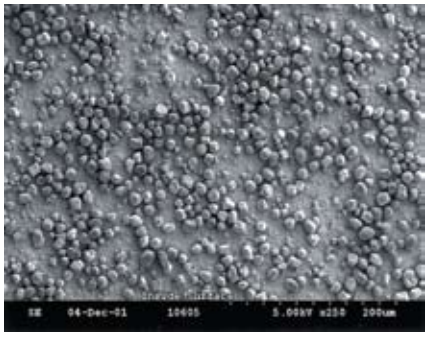

Image 8. Electronmicrograph of glove powder.

Powder released into this environment may be linked to complications such as glove-associated reactions, respiratory complications, and impaired wound healing. For example, powder can directly affect invasive dental procedures. Under the right conditions, powder provides essential nutrients to support microbial growth. When left behind in periodontal pockets and post-extraction sockets, powder can contribute to infection, trigger inflammation and delay healing.[24,25,26]

Therefore, powder-free gloves are recommended.[21,27,28] However, if powdered gloves are used:[16]

- Choose gloves with lower powder levels
- Reduce activities that disperse powder (e.g., snapping gloves on/off, tossing into trash)

Figure 1. Glove Powder Dispersion

Direct Contact

Inirect Contact

Aerosolization

Perferation or Tear

Conclusion

Considerations for the appropriate selection of medical gloves for dental professionals include physical characteristics and potential complications. Barrier integrity is a major concern for the wearer; therefore, it is critical to understand the level of protection and performance a glove provides in use. The glove should also feel comfortable for the wearer and not cause hand fatigue or restrict movement. Additionally, potential complications from glove-associated reactions and powder are critical considerations as they may impact not only the wearer but also the patient. A thorough understanding of all these issues will enable dental professionals to make a more informed decision when selecting medical gloves.

Accredited Education on this Topic:

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