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A COMPARATIVE EVALUATION OF EFFECT OF THICKNESS OF DIFFERENT TYPES OF GLOVES ON PERMEABILITY OF METHYL METHACRYLATE: AN IN VITRO STUDY

Dental Science

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ABSTRACT

Statement of problem: Permeability of Methyl Methacrylate through latex & non-latex gloves with different thickness is a controversial issue. This study had been done to comparatively evaluate non-powdered latex & non–latex gloves of different thickness in terms of their permeability.
Materials and method. The permeability of methyl methacrylate [MMA] to non-powdered latex & non latex (polyisoprene) gloves each with three different thickness were examined at different time intervals up to 60 minutes at 37°C. An equal number of Latex (n=90) and non-latex (n=90) gloves were included as Group I and Group II in the study. In both the groups, 3 subgroups (A, B & C) were made based on different thickness, each containing 30 samples.
Results. The result of the study exhibited that permeability of non-latex gloves (2.250+0.622 units) was found to be higher than that of latex gloves (1.775+1.035).
Conclusion. Within the limitations of the study, on comparing the difference in permeability of latex and non-latex gloves (polyisoprene), it was found that permeation of MMA was faster in polyisoprene gloves in comparison to latex gloves.

KEYWORDS

INTRODUCTION:

Gloves are used in the field of healthcare mainly as a protective barrier to prevent the transmission of diseases and physical exposure to chemicals. The routine use of protective gloves for dental procedures is regarded as a requirement for adequate infection control. To provide protection to the clinician, gloves must have a mechanical barrier to chemicals, pathogenic bacteria and viruses. The reliability of the protection afforded by dental gloves is linked intrinsically to their permeability.

Dentists encounter chemicals like monomers in their routine practice while making provisional restorations, performing desensitization procedures, providing complete denture treatment, making repairs and functional relining. People exposed to MMA occasionally suffer hypersensitivity, local neurological symptoms, irritation and local dermatological reactions.[1] With chronic exposure deep painful cracking, intermittent bleeding and eventually pigmentation results.[2] Hypersensitivity to leachable and diffusible components through surgical/dental gloves is a concern for health care professionals.[3]

The most frequently used glove material in the dental profession is natural rubber latex (NRL). Fries et al (JPD) reported that methyl methacrylate easily diffused through 18 different types of surgical gloves. A number of other experimental studies on the penetration of methacrylate monomers through various kinds of gloves have been performed.[13,18-22] Monomers with lower molecular weights, such as MMA and HEMA (2 – Hydroxy Ethyl Methacrylate), easily permeate clinical gloves[18]. It has been demonstrated that Methyl Methacrylate easily penetrates the latex as well as non-latex gloves.

Till date, no conclusive data is available in terms of permeability of Methyl Methacrylate to different thickness of dental gloves. Therefore, the aim of this study is to evaluate & compare the permeability of Methyl Methacrylate monomer through different thickness of latex and non-latex gloves.

METHOD:

Present study was carried out in the Department of Prosthodontics, Kothiwal Dental College in collaboration with Research Testing & Calibration laboratory (NABL Accredited laboratory), Moradabad.
Two types of gloves were chosen and divided into 2 groups based on the type of material:

1- Latex {Group I}
2- Non- latex (polyisoprene) {Group II}

Based on thickness, each group was divided into 3 subgroups. These were:

Table 1: Group wise Distribution of gloves

Group	Description	Subgroup	Description of Subgroup
Group I	Latex	Subgroup IA	Encore microptic 0.18 mm
		Subgroup IB	Encore 85 0.23 mm
		Subgroup IC	Encore orthopaedic 0.33 mm
Group II	Polyisoprene	Subgroup IIA	Gammex isoderm undergloves 0.19 mm
		Subgroup IIB	Gammex isoderm 0.23 mm
		Subgroup IIC	Derma prene isotouch orthopaedic 0.34 mm

Gloves from each subgroup were taken and tested for pin-hole defects according to of latex & non-latex gloves. Before starting the experiment, each glove was treated with ethanol to remove any traces of water in the gloves which may interfere with the readings of Spectrophotometer.

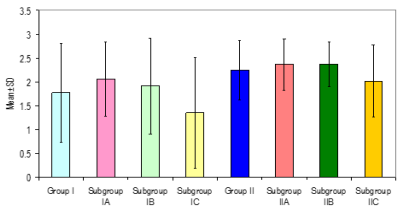
30 finger tips from each subgroup were taken. In this way 180 samples were tested for the study. Each sample was subjected to Methyl Methacrylate (MMA) permeability test using Spectrophotometer.

One finger of each glove (30 each in 6 groups) was cut and 500 µL of MMA was poured into each finger with the help of Multipette Plus. Two quartz sample cells were taken, one contained reference blank and second contained the test sample. Reference blank contained 25 mL of ethanol (99.5mg/dL) and was used to compare the absorbance of the test solution. Reference blank contained everything found in the sample solution except the substance meant to analyze or measure (methyl methacrylate). Second quartz cell had the cut glove finger containing the 500 µL of MMA which was then dipped into 25 mL of ethanol (99.5mg/dL). It was allowed to stand up to 60 minutes at 37°C. The amount of MMA that permeated into the ethanol was measured by a Spectrophotometer (DR- 5000; HACH, USA) at a wavelength of 310 nm at the interval of 1, 2, 3, 5, 10, 15, 30 minutes. The quantity of monomer that penetrated each gloves was determined by comparison

with known monomer quantity. The differences between the nature of gloves and their thickness were was then compared. The data so obtained from spectrophotometry were entered into Microsoft office Excel spread sheet and subjected to statistical analysis. Data collected were entered into Statistical Package for Social Sciences statistical software (SPSS) Version 15.0 statistical Analysis Software.

RESULTS:

An equal number of Latex (n=90) and non-latex (n=90) gloves were included as Group I and Group II in the present study. In both the groups,30 gloves each were included of similar thickness i.e. thickness 0.18-0.19 mm (Subgroup A), thickness 0.23 mm (Subgroup B) and thickness of 0.33-0.34 mm (Subgroup C) were assessed for permeability of methyl methacrylate monomer . Permeability of non-latex gloves (Group II) (2.250±0.622 units) was found to be higher than that of latex gloves (Group I) (1.775±1.035) and difference in permeability was found to be statistically significant.



Mean Permeability of MMA among all groups

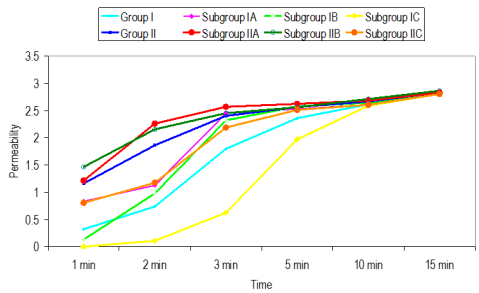
Table 6(a): Comparison of Permeability of Methyl Methacrylate Monomer (amongst all groups)

Group	No. of observations	Minimum	Maximum	Mean	S.D.
Group I	**540**	**0.000**	**2.835**	**1.775**	**1.035**
Subgroup IA	180	0.829	2.823	2.061	0.779
Subgroup IB	180	0.125	2.835	1.914	1.004
Subgroup IC	180	0.000	2.814	1.350	1.153
Group II	540	0.791	2.886	2.250	0.622
Subgroup IIA	180	1.211	2.882	2.364	0.543
Subgroup IIB	180	1.443	2.886	2.369	0.461
Subgroup IIC	180	0.791	2.823	2.016	0.758
Total	1080	0.000	2.886	2.012	0.886

At 1 minute, permeability of non-latex gloves (Group II) (1.163±0.274 units) was found to be higher than that of latex gloves (Group I) (0.322±0.368) and difference in permeability was found to be statistically significant ($p<0.001$). At 2 minutes, there was a statistically significant ($p<0.001$) difference in permeability of non-latex gloves (Group II) (1.864±0.492 units) which was found to be higher than that of latex gloves (Group I) (0.738±0.451)

At 3,5,10,15minutes, permeability of non-latex gloves (Group II) (2.404±0.161 units), 2.566±0.046 units), (2.668±0.064 units), (2.833±0.030 units) was found to be higher than that of latex gloves (Group I) (1.799±0.837), (2.360±0.277), (2.815±0.008) and difference in permeability was found to be statistically significant ($p<0.001$).

Comparing the difference in permeability of latex and non-latex gloves of similar thickness i.e. 0.18-0.19 mm, 0.23 mm and 0.33-0.34 mm a statistically significant difference was found that permeability was higher in non-latex subgroups ($p<0.001$).



Graph 1: Permeability of Methyl Methacrylate Monomer (amongst all groups)

DISCUSSION:

In spite of the proven efficiency of the MMA, it contains several contact allergens and studies show that dental personnel and patients may become sensitive to it**.** MMA is very hazardous to health if inhaled, swallowed or comes in contact with eyes and skin.[56] Methyl Methacrylate is a sensitizer and can cause an allergic contact type of eczematous reaction to oral mucosa and heat cure resin denture material has sufficient unpolymerized monomer to cause reaction in patients

Gloves are one of the most important protective equipment providing protection used more common in dentistry than in any other occupations. The gloves used in dental clinics have so far been tested mainly for the protection of the patients and the dental staff from viral or bacterial cross-contamination. They should, however, also provide chemical protection for their users, most important when managing MMA exposures at the work place, whether it is in the process of mixing, loading, distributing, or it is during handling of recently treated objects.

The most frequently used glove materials in the dental professions are natural rubber latex (NRL) and polyvinyl chloride (PVC), powdered or non-powdered. Nitrile rubber (NR) and polyethylene-copolymer (PE) gloves are also been used.

None of the presentable gloves provide complete protection to MMA and other chemicals used in dentistry. A number of experimental studies on the penetration of methacrylate monomers through various kinds of gloves have been performed and compared the permeability of monomer to different kind of glove material.

From the previous studies[18,41,48], it was confirmed that none of the gloves available provided the complete protection to MMA and other monomers. The penetration of MMA through a glove is a function of the material as well as the thickness of the glove.[48] The thickness affects both the breakthrough time and the permeation rate.[48] There are limited studies done on role of thickness of glove on its permeability.

In this study, all gloves chosen were free of pin hole defects. Permeability of methyl methacrylate (MMA) monomer through different gloves was tested. The amount of MMA that permeated into the ethanol was measured by a Spectrophotometer at a wavelength of 310 nm at the interval of 1, 2, 3, 5, 10, 15, 30 minutes. 310 nm wavelength was chosen because it was seen that maximum absorbance of MMA was found at wavelength of 310 nm.

The objective of present study was to comparatively evaluate the efficiency of different glove materials & thicknesses in preventing the chemical injury from MMA. In thick gloves, permeation of MMA was found to be slower. Concerned dental professionals should be encouraged to use thicker gloves when performing jobs where tactile sensation is less necessary. Double or triple gloving with available gloves may be effective for short-duration jobs, when a better material is not available. Even the most resistant materials will be penetrated quickly, so gloves should be replaced often.

Conclusion:

Within the limitation of the present study, the following conclusions were drawn:

1. On comparing the difference in permeability of latex and non-latex gloves (polyisoprene), it was found that permeation of MMA was faster in polyisoprene gloves in comparison to latex gloves.
2. In thinnest latex gloves permeation of MMA occurred within 1 minute where as in thickest latex gloves permeation occurred after 1 minute. Difference in permeability of gloves with different thickness was found to be statistically significant.
3. In polyisoprene gloves, permeation started within 1 minute regardless of thickness but the difference in permeability of gloves with different thickness was found to be statistically significant.
4. It was seen that thickness does have an effect on the permeability in both latex & polyisoprene gloves. MMA permeation was faster through thin gloves whereas in thicker gloves permeation was slower. The difference in permeability was found to be statistically significant.

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