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# Evaluation of Permeability of Commercially Available Latex Gloves for use in Dental Practice - *A Quality Check*

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## ABSTRACT

Cross infection control is an essential part of dentistry and barrier techniques form the core of foundation for infection control. Dentists use gloves as a barrier technique oblivious to the fact that gloves are not impermeable and help in cross infection control.

Therefore the purpose of this study was to evaluate the permeability of gloves before and after usage in various dental procedures.

The study was a double blind randomized trial consisting of five brands of gloves. Out of five brands three brands were sterile surgical in nature and the remaining two were examination type. The gloves were tested for permeability through air-water submersion test for macro defects and erythrosine dye leakage test. A total of five hundred gloves were assessed for permeability spread across five brands. The results showed that out of five hundred gloves, one hundred and three gloves proved to be defective. Forty gloves were found to be defective having macro defects through air-water submersion test and sixty three gloves had micro defects as assessed by erythrosine dye leakage test.

The study concluded by evaluating the impermeability status of the five brands of gloves and showed that none of the brands were effective in barrier control providing total protection to the dentist. The five brands of gloves showed varying number of macro and micro defects.

## INTRODUCTION

The colour of white is associated with the purity, sanctity and the mobility of the medical and dental profession. Similarly the donning of gloves is equated with asepsis, hygiene and infection control both by the patient as well as the dental community.

### But is that really true?

From the era of barehanded non-sterile dental practice to the present age of highly sterile hitech dentistry the quest for ideal barrier control continues. It is said that prevention is always better than cure and gloves occupy a pride of place and are a vital integral part of today's cross-infection control with the advent of deadlier pathogens like HIV and Hepatitis it is all the more imperative that barrier control techniques be that much more precise. Hence gloves should meet highly exacting standards of quality control and perfection.

In this volatile scenario comes the standardization and quality control of gloves- an issue which has not been addressed as emphatically and seriously as it should have been myriad studies have raised questions regarding the reliability of gloves in cross-infection control. We as dentists tend to use gloves oblivious to the fact that gloves are not impermeable and today's market are flooded with numerous brands of gloves for use in dental practice.

Therefore our primary concern was to evaluate the most important attribute of a glove i.e. their permeability status and also to follow up this permeability status check after the use of gloves in various dental procedures.

## MATERIALS AND METHODS

Gloves form the core of foundation over which the superstructure of barrier infection control techniques is built. The most fundamental and important characteristic of a glove is its impermeability and it is governed by myriad factors.

In a new, unused glove, it may depend on manufacturing faults, which include macroscopically evident lacerations and micropores occurring during industrial production. It may also depend on the quality of the rubber latex used and

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the method of treating the material, which determine the molecular dimensions and intermolecular spaces.

In a used glove, the factors that are possible for the permeability could be mechanical attack (cuts or puncture) and chemical attack (acids, bases and solvents) and after dental treatment procedures the other factors responsible for the deterioration of the gloves could be detergents and disinfectants with their resultant chemical action. Combination of all these factors can congregate in contributing to macroscopic and microscopic defects in the glove. Hence quality control processes to ensure strict adherence to the exacting standards should be employed, such as air water submersion test to check the macro defects and erythrosine dye leakage test for micro defects.

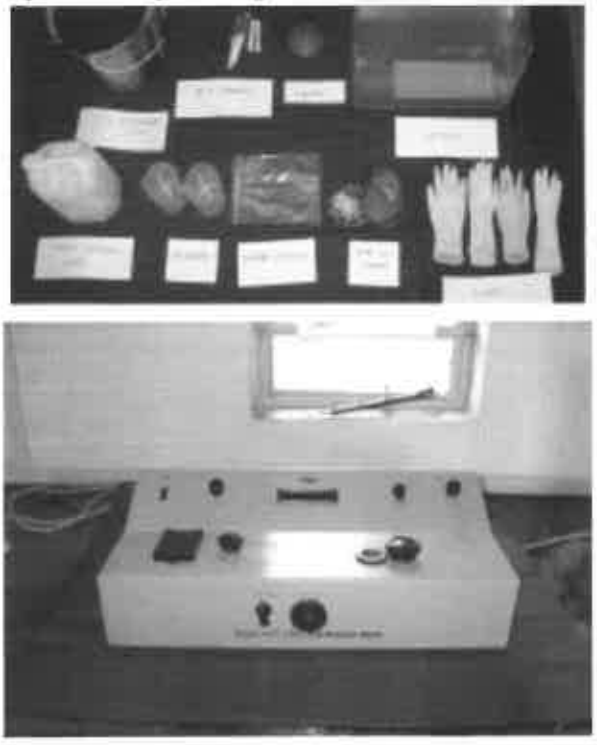


***Fig Materials used for the study***

The following brands of gloves were selected for the study obtained from the central stores of the college hospital and these were

1. Hygyn
2. Medigrip
3. Safecare
4. N+care
5. Rakshak latex


The first three brands of gloves were sterile surgical in nature and the remaining two were non sterile examination type.

100 gloves of each brand were chosen randomly for the study from the unopened boxes. The total of 500 gloves were coded numerically as part of the double blind procedure.

***Fig The gloves coded numerically as part of double blind procedure***

Out of 100 gloves of each brand 50 unused and coded gloves were directly assessed for permeability through air-water submersion test and erythrosine dye-leakage test. The other 50 gloves were used by the house-surgeons of the community department to carry out myriad dental procedures like root canal therapies, extractions, oral prophylaxis, restoration of cavities as part of the comprehensive oral health care programme.

Fig House surgeon carrying out dental treatment procedure

The gloves were collected back from the house surgeons in plastic pouches and coded together.

*Fig Gloves collected back in plastic pouches from house surgeons*

Each pair of glove was restricted to a single patient and regular sterilization procedures were taken care during the study. All the coded gloves which included used and unused gloves were examined together for permeability through air-water submersion test and erythrosine dye-leakage test in succession.

**The following tests were employed to check the permeability:**

*1. Air-water submersion test:*

According to British Standard (BS) 4005, each glove was filled with compressed air from an dental unit air syringe till one and a half the transverse diameter of the palm was reached.

*Fig*

After sealing the glove at the cuff, it was then immersed in a large trough containing about 10 litres of clear water.

*Fig*

The site of defect was located by a trail of air bubbles. This was considered as a macro defect.

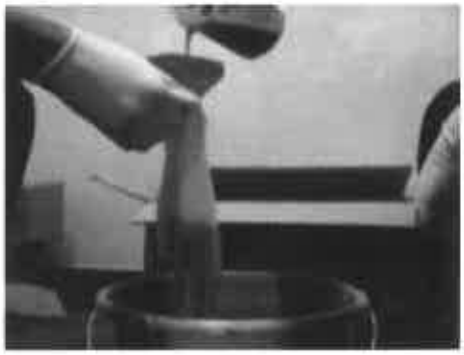
*Fig A site of macro defect located by trail of air bubbles*

*2. Erythrosine dye-leakage test:*

A solution was prepared containing 0.2ml of erythrosine dye per litre of water.

*Fig*

Each glove was then filled with 400ml of this solution with great care so that there was no spill-over on the external surface.



*Fig*

Then the outer surface of the gloves were washed with water and dried to avoid false positives. The gloves were then suspended for atleast 30 minutes and then the external surface of the gloves were washed with double-distilled water using a syringe.

*Fig Suspension of gloves for 30 minutes*

*Fig Washing of the external surface of the glove with double distilled water*

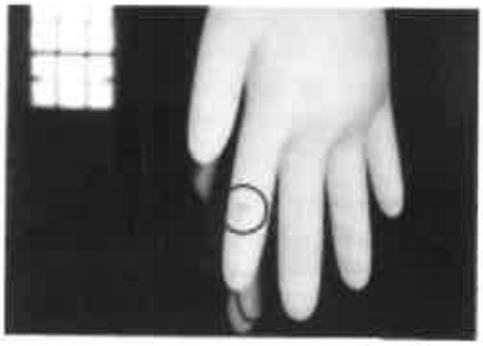


*Fig The round circle exhibits site of micro defect*

The washings were collected in a beaker. The beaker samples were then subjected to spectrophotometer for analyzing traces of dye and if traces of dye were found in the samples, that particular glove was termed as a defective glove having a micro defect.

*Fig Different concentrations of dye samples collected*

*Fig Analysis through spectrophotometer*

Both these tests were carried out in succession and later the number of defects were analyzed.

## RESULTS :

A total sample of 500 gloves were subjected for permeability tests through air water submersion test and dye leakage test. One of the astonishing finding was the revelation of 33 unused gloves proving to be defective of the total sample which accounts for 6.6%. Hygyn brand had the least number of defects when compared to other brands as shown in Table-1.

*Table - 1: Overall distribution of defective gloves of different brands*

| Brands | Total No. | Air water submersion | | Erythrosine dye leakage test | | Total |
|---|---|---|---|---|---|---|
| | | Unused | Used | Unused | Used | |
| Hygyn | 100 | 2 | 3 | 4 | 3 | 12 |
| Medigrip | 100 | 2 | 2 | 4 | 6 | 14 |
| Safe care | 100 | 1 | 4 | 3 | 9 | 17 |
| N+care | 100 | 6 | 6 | 8 | 8 | 28 |
| R latex | 100 | 1 | 13 | 2 | 16 | 32 |
| | 500 | 12 | 28 | 21 | 42 | 103 |

All the brands exhibited macro defect and micro defects. The brands Rakshak latex, n+care had an alarming rate of defects and the distribution of various brands of gloves that proved to be defective by air-water submersion test are given in Table 2.

*Table - 2: Overall distribution of defective gloves of different brands by air-water submersion test*

| Brands | Total No. | Air-water submersion test | | Total |
|---|---|---|---|---|
| | | Unused gloves | Used gloves | |
| Hygyn | 100 | 2 | 3 | 5 |
| Medigrip | 100 | 2 | 2 | 4 |
| Safe care | 100 | 1 | 4 | 5 |
| N+care | 100 | 6 | 6 | 12 |
| R latex | 100 | 1 | 13 | 14 |
| | 500 | 12 | 28 | 40 |

Safe care and Hygyn in the sterile surgical gloves category exhibited same number of defects for air-water submersion test as shown in Table-2.

*Table - 3: Distribution of various brands of gloves that proved to be defective by erythrosine dye leakage test.*

| Brands | Total No. | Erythrosine dye leakage test | | Total |
|---|---|---|---|---|
| | | Unused gloves | Used gloves | |
| Hygyn | 100 | 4 | 3 | 7 |
| Medigrip | 100 | 4 | 6 | 10 |
| Safe care | 100 | 3 | 9 | 12 |
| N+care | 100 | 8 | 8 | 16 |
| R lalex | 100 | 2 | 16 | 18 |
| | 500 | 21 | 42 | 63 |

Hygyn and n+care showed the least number of defects in the sterile surgical gloves and examination gloves segment respectively.

## DISCUSSION

It is clear from the results that all the brands of gloves had some form of defects, either a macro defect or a micro defect. It was astonishing to confirm the presence of defects in fresh unused gloves. The requirements of various controlling authorities around the globe regarding the failure rate of unused gloves vary, but there is broad agreement of 1.5 to 4% being the acceptable limit[1]. The present study reported 6.6% defect for the unused gloves. Various studies overseas have given a failure rate ranging from 2-35%. Checchi et al[2] in their study with similar tests found 12.4% defects among the gloves. Dodds et al found about 3% defects among the unused gloves and the present study showed 6.6% defects in case of unused gloves. According to Linda L. Otis et al[4] in their study showed 1.8% defect in unused gloves and the perforations showed upto 26% after the usage of the gloves and the present study overall showed upto 20.6% defects among both the used and unused gloves which is definitely higher for any quality control agency to accept such a high defective rate.

Different researchers have employed myriad testing methods to check the impermeability of the gloves like microbiologic and electrical conductivity test[5].

The present study employed air-water submersion test and erythrosine dye leakage test and these tests are incorporated in the schedule of British quality control agency and American Society of testing and materials[2]. The air-water submersion test was easy to perform and can be easily practiced in a private clinical setup. The erythorosine dye leakage test is a more critical and sensitive test as it revealed both macro and micro defects. Erythrosine dye is a dye of small molecular size, defined by the supplier as a mixture of disodium 2 (2457 tetra iodo 3 oxido-6-oxoxanthen-9-yl) benzoate. Serial dilution of the 0.2% dye solution demonstrated that the spectrophotometer was capable of detecting as little as $4 \times 10^{-5}$ of the dye in water i.e. 1 part in 2 million. The spectrophotometer detected the dye in the range 525nm wavelength[8].

Few researchers have adopted additional tests which they claim to be more sensitive and the tests include microbiologic test and electrical conductivity test. The microbiologic tests include passage of bacillus stearothermophilus through the gloves indicating permeability and the electrical conductivity test exhibits the permeability of a glove by passage of ions through it and indicated by an volt meter. The microbiologic and electrical conductivity test reveal macro and micro defects as well. If a comparison is made between the number of gloves with macroscopically visible holes and the gloves with microscopic holes not visible to the naked eye, a prevalence may be noted in the later group. This piece of information is important if we bear in mind that the most dangerous holes from the practical and the clinical point of view are the microscopic holes. The dentist is not aware of such holes and so uses the gloves with micro perforations with the possible risk of contamination. Even though a useful distinction is made between dental examination non-sterile disposable gloves and surgical sterile gloves, it should be remembered that safety must always be total.

## CONCLUSIONS :

***"Perfection is achievable; it's the journey that is difficult"***

The path to success in any endeavor is littered with obstacles and tribulations. This is especially true in the exacting field of dental infection control. Perfection in infection control is dearly sought after but rarely achieved without strict compliance and consciousness.

Gloves are an integral part of infection control and high quality standards are not only desirable but mandatory. In an effort to assess the glove's main attribute which is their impermeability, we conducted the present study and reached a deplorable conclusion that none of the brands of gloves assessed were satisfactory in terms of impermeability. Among the brands tested hygiene brand in case of sterile surgical gloves segment and N+care in case of examination gloves category were found to be less permeable.

Hence it is obvious that stricter and more efficient quality control measures have to be implemented to ensure gloves that allow ideal barrier control, thus breaking the cycle of infection and ensuring in safe guarding the health of the dentist and the patient.

## REFERENCES :

1. Ashish Jain, Silva I.D. "Physical and electroconductive evaluation of safety of Indian gloves". J. Indian Society of Periodontology, 1998; 1(3): 92-93.
2. Checchi, S. Conti, C.D. Achille "Evaluation of the permeability of latex gloves for use in dental practice". Quintessence International, 1991; 22: 949-959.
3. Jalie N. Katz, John P. Gobetti, Charles Shipman "Fluorescin dye evaluation of glove integrity". JADA, 1989; 118: 327-330.
4. Linda L. Otis, James A. Cottone "Prevalence of perforations in disposable latex gloves during routine dental treatment". JADA, 1989; 118 : 321-324.
5. Martin M.V., Dunn H.M., Field E.A., Field J.K., Hibbert S.A. McGowan P. and Wardle I. " A physical and microbiological evaluation of the re-use of non-sterile gloves". Br. Dent. J. 1988; 165: 321-324.
6. Morgan D.J. and Adams D. "Permeability studies on protective gloves used in dental practice". British Dental Journal, 1989; 166: 11-13.
7. Rustage K.J, Rothwell P.S and Brook I.M. "Evaluation of a dedicated dental procedure glove for clinical dentistry". British Dental Journal, 1987; 163: 193-195.
8. Tinsley D., and R.G. Chadwick "The permeability of dental gloves following exposure to certain dental materials". Journal of Dentistry, 1997; 25: 65-70.