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The effect of wearing latex gloves on the accuracy of pulse oximeter readings to prevent cross-contamination

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Abstract---Background: Pulse oximeter is a painless and non-invasive device used to measure oxygen saturation level. In December 2019, an outbreak of coronavirus disease was caused by a novel severe acute respiratory syndrome coronavirus-2 (SARS-2). They are a large family of viruses that causes illness ranging from the common cold to the

most severe disease such as MERS (Middle East Respiratory Syndrome) and SARS (severe acute respiratory syndrome). Since it affects the respiratory system, the use of a Pulse oximeter has increased significantly to measure oxygen saturation level. **Objective:** The objective of the study is to analyze any discrepancy in the accuracy of pulse oximeter readings when taken with or without latex gloves. **Method:** A total of 100 individuals were selected who satisfied the inclusion and exclusion criteria. The pulse oximeter was placed on the right middle finger and a reading for oxygen saturation level in arterial blood was obtained after 3-5seconds. Two parameters such as reading with latex gloves and without latex gloves pulse oximeter reading were measured. The data obtained were statistically analyzed. **Result:** Upon statistical analysis no significant difference was found between the value on the patient wearing gloves or without wearing gloves. **Conclusion:** Hence, wearing gloves protect from cross-infection without affecting accuracy of the pulse oximeter.

Keywords---coronavirus disease, gloves, oxygen saturation, cross-infection, pulse oximeter.

Introduction

A pulse oximeter is convenient, reliable, and accurate non-invasive equipment used to measure oxygen saturation level, pulse rate of the individual and hence, detect hypoxemia. They are critically important in emergency medicine. It detects hypoxia before the patient can become cyanosed. It can be used alone or can be incorporated into a multiparameter patient monitor. It displays the percentage of haemoglobin saturated with oxygen together with the calculated heart rate, a graphic representation for blood flow. The current Pandemic situation the world is facing affects the respiratory system as the patient feels difficulty in breathing. So, continuous monitoring of the saturated oxygen levels in the affected patients with a pulse oximeter helps to make the situation within control. In dentistry, various other conditions where it can be used such as:

1. Before regular orthodontic appointments
2. During the Implant placement procedure
3. Before and during orthognathic surgeries
(In Surgical phase: Mandible- Bilateral sagittal split osteotomy (BSSO)/
Genioplasty, Midface- Le Fort I osteotomy)
4. Before and during Distraction Osteogenesis
5. During open reduction of fractures
6. During flap surgeries
7. When a patient is given conscious sedation
8. Throughout anaesthesia during surgery
9. While doing any procedure on a patient with long-standing respiratory disease
10. Patient with dental fear and anxiety
11. During dis-impaction procedures
12. During the recovery phase

Mechanism of Action

Pulse oximeter consists of a probe with a pair of the light-emitting diode (LED) and a detector which is attached to the finger, toe, ear lobe, nose, forehead¹. The emitter and a detector are placed so as to face each other through the tissue of about 5-10 nm thickness². It consists of a red LED of wavelength about 660nm and an infrared LED with a wavelength of about 940nm³. Oxygenated and Deoxygenated Hemoglobin shows a significant difference in absorption of these wavelengths. Oxyhaemoglobin is formed when oxygen binds to the heme component of the protein hemoglobin in red blood cells. Deoxyhaemoglobin is the form of hemoglobin without any trace of bound oxygen. The absorption spectra of both Oxygenated and Deoxygenated Hemoglobin differ. Oxyhaemoglobin has lower absorption of 660nm wavelength than deoxyhaemoglobin whereas at 940nm its absorption is higher. This difference is used to measure the amount of oxygen in the patient's blood and hence, oxygen saturation level. The normal range of oxygen saturation is from 95-100 percent. It works on the principle of spectrophotometry and plethysmography.

Material and Method

This study was conducted to evaluate the effect of using latex gloves on the accuracy of pulse oximeter reading. A total of 100 individuals were selected for this study. The selected individuals range from 18-30 years of age. The subjects were selected following the inclusion and exclusion criteria and informed consent was taken from the subjects before the initiation of measurements. All the measurement recorded were by ensuring a good seal and by avoiding motion artefact⁴.

Materials

1. Pulse oximeter (infi CE, Finger Tip Pulse oximeter) (Figure-1)
2. Latex gloves (Ramsons, Examination Glove) (Figure-2)



Figure-1: (Pulse Oximeter) original



Figure-2: (Latex gloves)original

Inclusion criteria

1. All the selected individuals were of age between 18 -30years.
2. No history of any respiratory, heart diseases.

Exclusion criteria

1. Individuals with any sign of a cough, rhinorrhoea
2. Individuals with any heart disease
3. Individuals with any disease related to the respiratory system such as Asthma, were not considered in the study.
4. Individuals with the habit of smoking.
5. Individuals with Obstructive Sleep Apnea disorder

While conducting the study a special factor was considered that is no individual has applied nail polish on the nails. Individuals were seated on the chair in a relaxed position. The procedure was explained to the individual and consent was taken. Two readings were measured with a pulse oximeter one with an individual wearing latex gloves pulse oximeter was placed on the right middle finger and a reading fo(Figure-3)andanother value of the same individualwithout wearing latexgloves(Figure-4). The r oxygen saturation level in arterial blood was obtained after 3-5 seconds.



Figure-3: (Individual with latex gloves)original



Figure-4: (Individual without latex gloves)original

Table-1: Readings of Pulse oximeter (Original)

	With gloves	Without gloves
SpO ₂ %	97	99

Data collected were statically analyzed.

Result

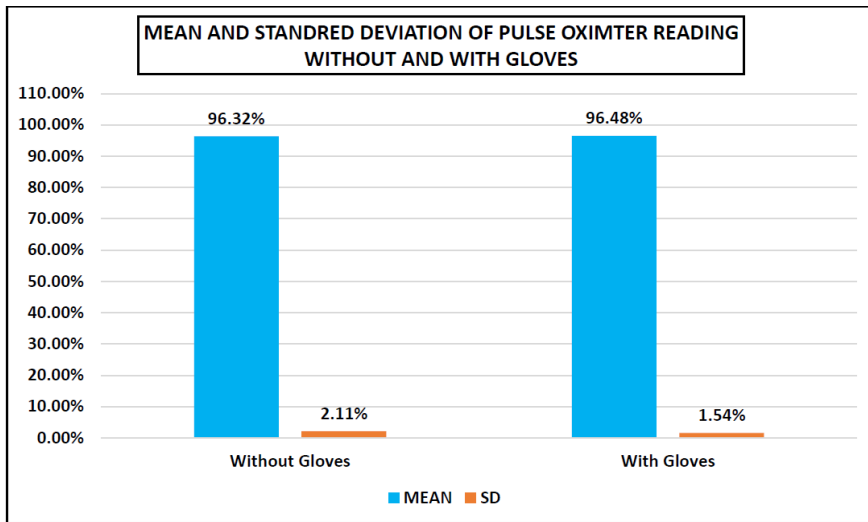
A total of 100 individuals were included to evaluate the effect of wearing latex gloves on the accuracy of Pulse oximeter readings to prevent cross-contamination. The results of the measurements were analyzed using one-way analysis of variance (ANOVA) test. The parameters when compared between without and with gloves was found to be statistically not significant (P =0.5413).

Table-2: Comparison of oximeter reading in percentage without and with gloves using one way ANOVA test (Original)

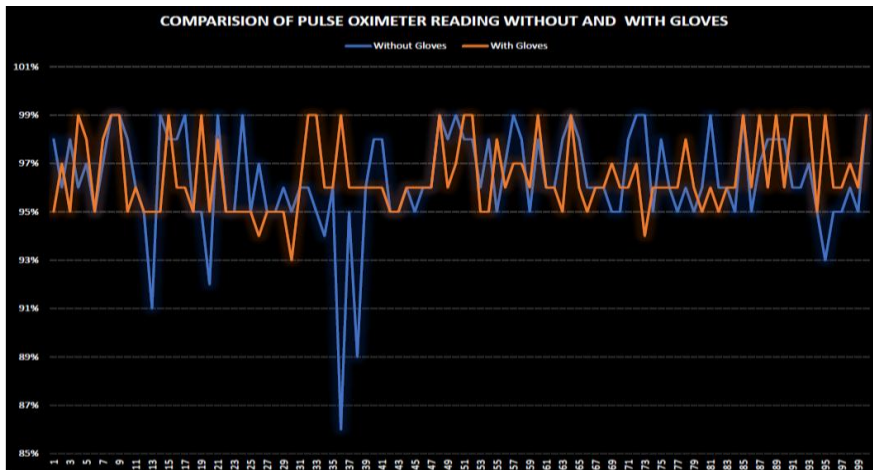
Pulse Oximeter Reading	Mean	SD	F	P	STATUS
Without Gloves	96.32%	2.11%	0.3745	0.5413	Non-significant
With gloves	96.48%	1.54%			

The mean values for without gloves and with gloves are 96.32% and 96.48% respectively.

Graph-1: Mean and standard deviation of readings (Original)



Graph-2: Comparison of readings (Original)



Discussion

COVID-19 is a viral disease with symptoms similar to that of common flu. Dentists and their dental staff including assistants, specialists and patients are potentially at higher risk of COVID-19 infection during dental treatment⁵. Globally people are learning the best ways to assess its severity in the community. In low resource settings where oxygen supplies and monitored beds are scarce, pulse oximeter is considered as a crucial device for diagnosis triaging patients and establishing the need for supplemental oxygen⁶. Early recognition of hypoxia and oxygen administration has been shown to reduce mortality⁷.

In the present study, it was decided to proceed by taking the reading from finger probe rather than other probes such as ear, nose, and forehead. A study conducted by Clayton et.al in 1991 where he compared the pulse oximeter readings between four probes that is finger, ear, nose, and forehead and recommended the use of a finger probe rather than any other probe¹. Moreover, out of the finger probe, the pulse oximeter was attached to the middle finger as the Perfusion Index remains almost unaffected in normal as well as during hypoperfusion⁸ whereas rest all other phalanges show affected values in hypoperfusion.

Another factor which was considered during the study was that no individuals have applied any nail polish on the nails. A study conducted by Cote et.al in 1988 states that nail polish caused a significant lowering of SpO_2 reading, especially black, green and blue color that represents an average error of 3%, 5%, and 6% respectively⁹. This may be due to the difference in effect to the absorption spectra of these colors. Moreover, we did not use any other color gloves as different color absorbs light of different wavelength and that may interfere in the precise recording of pulse oximeter reading.

One can use a pulse oximeter with the use of hand sanitizers to prevent cross infection. Sanitizer containing more than 75% alcohol is more effective in destroying the microorganisms than handwashing with anti-microbial soaps due to their ability to inactivate and destroy the microbes¹⁰. However, its use results in dry skin, itching, redness of the skin, and in some cases eczema of the skin¹¹. Besides, repeated use of alcohol-based sanitizer can damage the device sensor thus affecting its accuracy. The Pearson correlation coefficients (P value) were relatively small but significant for with and without gloves. Hence, using pulse oximeter by wearing gloves can protect from cross-infection.

Conclusion

Pulse oximeter can be a useful aid to clinical decision making but is not a substitute for a clinical assessment, nor it is sufficient for diagnosis by itself. It is valuable in triaging potentially hypoxic patients in the home or surgery centre to help determine which patients require further assessment or treatment. Thus, taking a simple precautionary measure by wearing gloves can protect from infection without affecting the device precision and its accuracy. This study helps to use the device in mass screenings and in large group of people.

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