2015-5435/14/63-22-26
INTERNATIONAL JOURNAL OF OCCUPATIONAL HYGIENE

IJOH 7: 22-26, 2015

ORIGINAL ARTICLE

An Investigation of the Impact of Using Latex and Nitrile Gloves on Hand Dexterity

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Received December 28, 2014; Revised January 19, 2015; Accepted April 10, 2015

This paper is available on-line at *http://ijoh.tums.ac.ir*

ABSTRACT

The present study was conducted to examine the effect of using latex and nitrile examination gloves on hand dexterity. A sample consisting of 30 university students from Urmia University of Medical Sciences participated in this study in 2013. The participants conducted Purdue pegboard test in three experimental conditions: bare hand (control), with latex gloves and with nitrile gloves. Both gross and fine finger dexterity tests were calculated and result of analysis showed that the differences between three groups of experimental condition from level of gross to fine finger dexterity was statistically significant (P=0.021, P=0.025). Levels of both gross and fine finger dexterity with latex gloves were significantly different from the nitrile gloves (P=0.021, P=0.009) and levels of both gross and levels of both gross and fine finger dexterity with latex gloves was slightly significant different comparison to bare hand (P=0.023, P=0.019). Use of latex gloves could slightly improve dexterity; however, this effect was not observed while using nitrile gloves. The present study confirmed nitrile gloves as an alternative for latex gloves without loss of dexterity in large and small hand movements.

KEYWORDS: *Latex gloves, Nitrile gloves, Hand dexterity, Dexterity test, Purdue pegboard test*

INTRODUCTION

Use of gloves is necessary for protection against harmful agents; however, it is usually associated with decreased manual dexterity. One of the common types of gloves that are frequently used among health care workers and laboratory technicians is latex gloves, which are made of natural latex. Latex is produced by a plant called Bransiliensis Herrera and is milky liquid. This material is used in various industrial processes for producing various products such as gloves and balloons.

"Archaeologists have found that latex items were used as early as 1600 BC, but it took until approximately 1900 AD before surgical gloves were commonly used" [1]. Now, with increasing trend of requirements for health services and subsequent increased use of latex gloves as an effective protection for infection control, prevalence of allergic reactions to latex has dramatically increased. Those staff in contact with latex gloves and other products containing natural rubber latex have reported various allergic reactions with symptoms ranging from minor skin irritation, hives, itching, watery eyes, runny nose and sneezing to systemic anaphylaxis; the latter is a serious life-threat ending condition [1-2].

Increasing recognition of latex allergy led to divergent paths of investigation, as in recent years, for resolving health problems of latex, nitrile gloves have been proposed as an alternative [3]. These gloves have been reported to provide the same level of protection against a variety of traumatic physical and chemical agents as latex; besides, they have high resistance to puncture and perforation [4]. It should be noted that no case of allergic reactions have been reported in use of nitrile gloves thus far.

However, decline of manual dexterity due to wearing these gloves in manual tasks, especially those that are require fine movement of fingers such as surgery, has been a concern because of

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probable adverse outcomes and this issue has not been sufficiently investigated yet.

Nitrile gloves have different physical properties to latex [4], which could affect the dexterity of the user. There are rare studies on this subject, most of which have focused on latex gloves. The results have shown decline in hand dexterity and sensory and motor function while using latex [5-6]. In some cases, conflicting results have been reported so did not shown significant differences in the test results for distinguishing between touch and manual dexterity tests using latex gloves and double latex gloves [7-8]. Some studies reported significant differences in the score of manual dexterity while using nitrile and latex gloves [9-10].

Given the limited research on the impact of medical gloves on manual dexterity and contradictory results in previous studies and recommendations for examining other manufacturer's gloves, this study was designed to explore the effects of medical gloves that manufactured in Iran.

MATERIALS AND METHOD

Participants: This study was conducted on 30 students that were randomly selected from Urmia University of Medical Sciences in 2013. The study population included 50% male and 50% female. Their age range was between 18 and 31 (with mean age and standard deviation of 22.5±2.87). All the participants were examined using two types of gloves. In order to eliminate effect of learning test, they were divided into two groups (each group consisted of 15 subjects); the first group conducted the test with latex and then nitrile gloves and another group did the reverse.

Purdue pegboard test: This study was conducted using the test and procedures described and validated by Tiffin [11]. Fig. 1 shows Purdue pegboard test. Purdue pegboard test is a standard test developed to assess fine and gross motor dexterity in applicants for industrial assembly work and composed of components of washer, collar and pins that were placed in the holes embedded in the test. Then, both fine and gross dexterity were measured.

Gross dexterity included manipulation of large objects with controlled movements of hand and arm that was derived from total score of three tests. The final test score was total number of pins which were placed into the holes embedded in the test Purdue pegboard, in the first test, by the dominant hand, in the second test, using the non-dominant hand and finally, in the third test, with the help of both hands. The time required for completing each step of the test was 30 sec.

Fine finger dexterity included manipulation of tiny objects with controlled movements of hand and fingers, which was measured using assembly test. The assembly test was done as follows: the participant first picked up the pin by the dominant hand and put it inside the holes embedded in the pegboard. Then, using the non-dominant hand, they picked up the washer and drop it over the pin; using the dominant hand, the collar was picked up and dropped over the washer. In the final step, using non-dominant hand, another washer was picked up and dropped over the collar. The number of components assembled in the end of 60 sec included pin, collar and washers which were recorded as the score of fine finger dexterity.

Fig 1. The Purdue pegboard test

Gloves: Two types of latex and nitrile gloves manufactured by an Iranian company, in three sizes of small, medium and large were provided for the participants. Fig. 2 shows the latex and nitrile gloves used in this study.

Description of analyses: To analyze the data, statistical analysis of repeated measures, t-test and Pearson's correlation coefficient were used. Alpha level was set at 0.05 for statistical significance. Statistical analysis was conducted using SPSS 16 (Chicago, IL, USA). Normality of the data was confirmed using nonparametric test of Kolmogorov-Smirnov.

Fig 2. Left: nitrile gloves, Right: latex gloves

Published online: April 20, 2015

Procedure: The participants were asked to wear the gloves fit with their hand size, then sit down on the chair behind the desk, and conduct tests by each two types of latex and nitrile gloves and once bare hand (control condition). Each participant was allocated a practice time before the test.

Measurements for the dominant hand of each subject were taken using calipers and recorded prior to the dexterity testing. Measured dimensions were including length (by specifying bony landmarks) and Width (at a halfway point on the distal phalange) of index, middle and thumb finger (which are mainly involved in assembly tasks). Fig.3 shows the measured dimension.

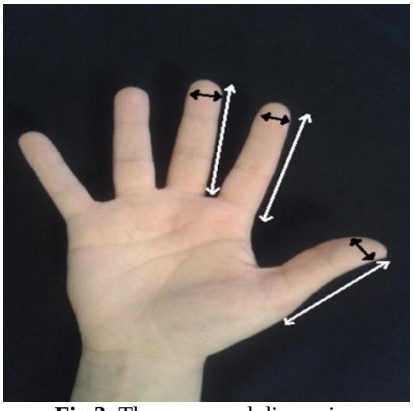

Fig 3. The measured dimension

RESULTS

Fine finger dexterity: One of the goals of this study was to investigate fine finger dexterity when using latex and nitrile gloves. Mean and standard deviation of fine finger dexterity of three groups of experimental conditions (control, latex gloves and nitrile gloves) are shown in Table 1. The results indicated statistically significant differences between the three groups of experimental conditions in terms of fine finger dexterity score (F (2, 58) =4.16; P=0.021). Multiple comparison tests revealed significant differences between levels of fine finger dexterity provided by latex gloves in comparison to nitrile and slightly significant differences between levels of fine finger dexterity provided by latex gloves in comparison to control group (bare hand). However, fine finger dexterity level of using nitrile gloves was not significant in comparison to the bare hand.

Table 1. The mean and standard deviation of fine finger dexterity of three experimental conditions is presented. (Groups with different symbol are significant)

Group type	Mean	Standard deviation	Symbol
Control	31.10	6.61	A
Latex gloves	33.90	7.75	B
Nitrile gloves	31.02	6.83	A

Gross dexterity: The second objective of this study was to measure gross dexterity score obtained by the sum of scores of using dominant hand, non-dominant hand and both hands. Scores of gross dexterity in three experimental groups (control, latex gloves and nitrile gloves) are shown in Table 2. Result of the analysis indicated statistically difference between three experimental groups in terms of score of gross dexterity.

Results of multiple comparison tests demonstrated significant differences between levels of gross dexterity provided by latex gloves, nitrile gloves and bare hand (F (2, 58) =4.00; P=0.025). Gross dexterity level of using nitrile gloves was not significant in comparison to the bare hand and gross dexterity level of using latex gloves was slightly significant in comparison to the bare hand.

Table 2. Mean and standard deviation of gross dexterity of three experimental conditions (Groups with different symbols are significant)

Group	Mean and standard deviation			Symbol
	Right hand	Left hand	Both hands	
Control	14.66 ±2.18	14.03 ± 2.20	10.00 ±1.25	A
Latex gloves	15.93 ±1.61	14.36 ±1.95	10.46 ±1.38	B
Nitrile gloves	15.16 ±1.55	13.7 ±1.68	10.33 ±1.51	A

Hand dimension: Six hand anthropometric dimensions of the participants were measured. Mean and range of these dimensions are presented in Table3. Correlation analysis suggested a weak significantly negative relationship between fine finger dexterity score and width of thumb finger (r=-0.361, P=0.05), right hand gross dexterity score and width of index finger (r=-0.371, P=0.04), and total score of gross dexterity and width of middle finger (r=-0.513, P=0.004). A significantly negative correlation was also found between total score of gross dexterity and width of index finger (r=-0.450, P=0.013), width of middle finger (r=-0.513, P=0.004), width of thumb finger (r=-0.450, P=0.01) and length of middle finger (r=-0.450, P=0.03).

Age and sex: There was no significant relationship between age and sex on the one hand and dexterity score of the three experimental groups on the other.

Published online: April 20, 2015

Table 3. Mean and range of hand anthropometric dimensions of the participants

Digit and dimension	Mean	Range (min-max)
Thumb length	66.56	95-59
Index finger length	94.56	82-104
Middle finger length	103.17	84-115
Thumb width	18.1	14-21

DISCUSSION

Loss of dexterity resulting from wearing latex and nitrile gloves is very important for employees of health services, especially surgeons who require high dexterity level in performing fine movements. Effect of these gloves on gross and fine hand dexterity has not been studied among Iranian populations. Results of this study identified that use of latex gloves caused significant increase in both fine and gross hand dexterity compared to nitrile gloves. In a similar study, Sawyer and Bennett were found that fine finger dexterity was increase with latex than with nitrile examination gloves [10]. Tasks, protocol and method use in study was similar to the present study and the results were in line with this findings. In a recent study [8] that compared the dexterity level in three conditions: without gloves and with single and double layers of latex surgical gloves, using the Purdue pegboard test, did not found any significant differences between all experimental conditions. These findings might be evidence that latex gloves due to their special features such as elasticity, can overcome on negative impact of the use gloves on manual dexterity. However, in the present study was found a slight increase (2-3 score) in hand dexterity when using latex gloves compared to the control condition. These findings, as well as some previous studies as mentioned above have questioned the fact that wearing gloves reduces manual dexterity. Thus, one of the hypotheses that can be raised here is the subject of inappropriateness of Purdue Peg Board test in this type of study. A new battery of tests specific must be designed to medical gloves that would simulate real medical tasks, produce repeatable result, and have sufficient resolution to differentiate between gloves types [12].

Physical characteristics of gloves: Physical characteristics of gloves such as thickness and elasticity are another effective factor for hand dexterity. Latex gloves were slightly thicker than nitrile gloves in terms of thickness (0.02 to 0.03 mm) and high thickness of gloves reduced sensory and motor function. However, latex gloves had features such as elasticity and high viscosity compared to nitrile that made them to have more fit with fingers and improve dexterity [10]. Results of this study also revealed increasing dexterity (fine finger and gross dexterity) while using latex gloves.

Hand dimension: Another factor that might influence dexterity was hand dimension. Pattern of hand anthropometric dimensions in the studied participants and their dexterity score revealed that people who had thinner hands have high dexterity level. Therefore, dexterity was also affected by width of the fingers. This was in line with the findings by Sawyer and Bennett [10].

Gloves selection: In this study, only latex and nitrile gloves from one manufacturer were tested. The results from the gloves tested might be difference between latex and nitrile gloves from other manufacturers. We hoped this study provides valuable information about this gloves type.

One of limitation of this study was using only two types of gloves from one manufacturer, while different types of gloves are produced by a range of manufacturers. It is recommended that the dexterity levels provided by gloves of other manufacturers be evaluated, too.

CONCLUSION

As a final result, no significant difference was observed in score of both fine finger and gross hand dexterity while using nitrile gloves compared with control conditions (without gloves). In other words, using nitrile gloves had no adverse effects on hand dexterity; therefore, its use was confirmed as an alternative for latex gloves considering the advantage of absence of any allergic reaction.

ACKNOWLEDGEMENTS

This study was fully supported by Urmia University of Medical Sciences with project number 1337. Acknowledgements are due to vice chancellery for research, Urmia University of Medical Sciences for funding this project.

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Published online: April 20, 2015