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Research Article

EFFECT OF SAFETY GOGGLES AND FACE SHIELDS ON TEAR PARAMETERS

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ABSTRACT

Background and objectives: The purpose of our study was to determine the effect and compare the changes between safety goggles and face shields on tear film parameters.
Methods: The total sample size of our project was 60, which were equally distributed between two groups of 30 subjects each, group 1 being safety goggles and group 2 of face shields. Baseline measurement of NITBUT and TMH using tearscope was taken and then subjects of group 1 were asked to wear safety goggles for 1 hour and group 2 subjects were asked to wear face shields for 1 hour and measurements of NITBUT and TMH were taken again.
Results: TMH and NIBUT mean baseline for both eyes were found to be significantly decreased post use of Safety goggles and Face shield from baseline values ($p < 0.001$).TMH and NIBUT parameters were more effected inthe safety goggle group.
Conclusion: Both safety goggles and face shields have shown a significant decrease in values of tear film parameters. In comparison, safety goggles have a greater effect than face shields.

INTRODUCTION

Safety goggles and face shields are personal protective equipment. Safety goggles are protective eye wears used in various fields such as chemistry laboratories, woodworking, swimming, and PPE kits. The material used to manufacture the goggles should be unbreakable, highly transparent and hypoallergic. Face shields are also personal protective equipment which aims to protect the wearer's entire face from hazardous substances like road debris, chemical splashes, infectious materials, flying objects etc. There are various types of safety goggles and face shields available according to one's profession. A study showed that the use of surgical masks for the entire whole day decreases TBUT and increases dry eye symptoms [1]. In Feb 2020, a report raised the issue that the ocular surface maybe a potential target for SARS COV-2 invasion. Although a small number of Covid-19 patients have conjunctivitis [2]. Health care providers must use eye protection to avoid the incidence of infection, thus there has been an increased usage of safety goggles and face shields among doctors, nurses, health care providers etc. In April 2020, a study was conducted to check the effect of swimming goggles on NIBUT in a laboratory setting. The study concluded that there was decreased NITBUT among the subjects after the usage of swimming goggles [3]. As safety goggles also have the same profile as the swimming google, safety google may also cause changes in tear film parameters. . Leaving aside the personal characteristics and lifestyle habits as factors associated with DED [10], the NITBUT has demonstrated to be altered by multiple causes, such as wearing contact lenses, computer work adverse environmental conditions (low humidity, air conditioning, pollution), the medication used or refractive or cataract surgery among others [4-14]. Facemask and any protective eyewear combined can further increase effect to tear film, it is necessary to evaluate what is the effect of these protective eye wears on tear films. So, our study aims to evaluate on the effects of safety goggles and face shields without the mask on the tear film and check whether it can affect the NITBUT and TMH of the tear film.

NITBUT is a non-invasive method to evaluate tear film break-up time which is an important diagnostic element for dry eye check-ups. In the TBUT test the presence of fluorescein in tears may stimulate reflex tearing and give a false result. To overcome this limitation, we use non-invasive procedure [20-22]. Tear meniscus is a thin strip of tear fluid with concave outer surface at the upper and lower margins. It contains more of exposed tear volume [23]. The absence of tear meniscus height is an indication of dry eye [8]. In our study, we have used an instrument Tearscope to analyse the tear film.

MATERIALS AND METHODS

The study was conducted at Nethradhama School of Optometry, in association with Nethradhama Super Speciality Eye Hospital. A total of 60 subjects were enrolled in the study. All subjects underwent full ophthalmic evaluation. The

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subjects enrolled in this study accomplished the following inclusion criteria: (a) No dry eye disease, (b) free from a ocular or systemic disease, (c) not under any ocular or systemic medications, (d) subjects should not be using any artificial tears, warm compressors or lid hygienic products, (e) contact lens wearers and (f) low grade Myopes (-0.25D to -2.75Dsph).Each subjects were informed about the study purpose and procedure, and written consent was obtained. Subjects were randomly equally distributed between two groups of 30 subjects, group 1 being safety goggles and group 2 of face shields. The subjects were asked to sit without surgical masks for 2 hours to eliminate the effect of the mask on tear film. After 2 hours, baseline measurement of NITBUT and TMH was taken. Group 1 subjects were asked to wear safety goggles and Group 2 subjects were asked to wear face shields for 1 hour. After 1 hour, the post readings of NITBUT and TMH were recorded using the Tearscope.

Statistical Analysis

All the statistical analysis were carried out with SPSS PC software version 25.O. Test for normality for our sample was performed using the Kolmogorov Smirnov test as our sample size was more than 50. For comparison between two related sample groups, we have used paired t test and for comparison between two groups unrelated sample, we have used an independent t-test. A pvalue less than 0.05 was taken as statistically significant.

RESULTS

A Total sample size of 60 subjects were enrolled in the study (N=30 in each group) (group 1 – safety goggles, group 2 – face shields) with mean age of 21.65(1.71) years (Range 18-30 years).

Table 1 Pre and Post SG changes in Mean (SD) NITBUT for OD and OS

	PRE NIBUT (sec)	POST NIBUT (sec)	p value
OD	12.15 (2.21)	9.87 (1.05)	0.001*
OS	12.01(2.26)	9.75 (1.09)	0.001*

Table 1 shows the mean baseline of NITBUT for OD and OS was found to be 12.15 (2.21) seconds and 12.02 (2.26) seconds respectively and post-safety goggles after 1hour which significantly decreased to 9.87 (1.05) seconds and 9.75 (1.09) seconds for RE and LE respectively (pvalue <0.001).

Table 2 Pre and Post SG changes in Mean (SD) TMH for OD and OS

	PRE TMH (mm)	POST TMH (mm)	p value
OD	0.28(0.05)	0.20 (0.03)	0.001*
OS	0.28 (0.05)	0.19 (0.03)	0.001*

Table 2 shows the mean baseline value of TMH for OD and OS was found to be 0.28 (0.05) millimetres and 0.28 (0.05) millimetres respectively and post safety goggles after 1hour which significantly decreased to 0.20 (0.03) millimetres and 0.19 (0.03) millimetres for RE and LE respectively (pvalue <0.001).

Table 3 Pre and Post FS changes in Mean (SD) NITBUT in OD and OS

	PRE NIBUT (sec)	POST NIBUT (sec)	p value
OD	11.99(1.70)	10.64(1.14)	0.001*
OS	11.98(1.74)	10.79(1.31)	0.001*

Table 3 shows mean baseline of NITBUT for OD and OS was found to be 11.99 (1.70) seconds and 11.98 (1.74) seconds respectively which significantly decreased (pvalue <0.001) to 10.64 (1.14) seconds and 10.79 (1.31) seconds for RE and LE respectively, post usage of face shields for 1hour.

Table 4 Pre and Post FS changes in Mean (SD) TMH in OD and OS

	PRE TMH (mm)	POST TMH (mm)	p value
OD	0.29(0.05)	0.22 (0.03)	0.001*
OS	0.28(0.05)	0.21 (0.03)	0.001*

Table 4 shows mean baseline of TMH for OD and OS was found to be 0.29 (0.05) millimetres and 0.28 (0.05) millimetres respectively which significantly decreased (pvalue <0.001) to 0.20 (0.03) millimetres and 0.21(0.03) millimetres for RE and LE respectively after the usage of face shield for 1 hour.

Table 5 Mean (SD) NIBUT Post Mean SG and FS in OD and OS

	SG NIBUT (sec)	FS NIBUT (sec)	p value
OD	9.9 (1.05)	10.6 (1.14)	0.009*
OS	9.8 (1.09)	10.8 (1.31)	0.002*

Table 5 shows mean post-reading of NIBUT for RE was found to be 9.9 (1.05) seconds and 10.6 (1.14) seconds, for safety goggles and face shields respectively showing a significant difference (p value = 0.009) in the comparison. For LE the mean NITBUT reading was found to be 9.8 (1.09) seconds and 10.8 (1.31) seconds for safety goggles and face shields respectively showing a significant difference (p value =0.002) in comparison between these two equipment's.

Table 6 Mean (SD) TMH Post Mean SG and FS in OD and OS

	SG TMH (mm)	FS TMH (mm)	p value
OD	0.21 (0.04)	0.22 (0.03)	0.85
OS	0.19 (0.04)	0.21 (0.03)	0.13

Table 6 shows the mean post reading of TMH for RE was found to be 0.21 (0.04) millimetres and 0.22 (0.03) millimetres, for safety goggles and face shields respectively showing no significant difference (p value = 0.85) in the comparison. For LE the mean NITBUT reading was found to be 0.19 (0.04) millimetres and 0.21 (0.03) millimetres for safety goggles and face shields respectively showing no significant difference (p value =0.13) in comparison between these two equipment's.

DISCUSSION

In our study, the effect of safety goggles on NITBUT and TMH has seen a significant decrease in value post usage. A similar study by Jesus Vera et al in the year 2020 shows a decrease in NITBUT post swimming goggle usage. [3] Our study has also shown a significant decrease in NITBUT and TMH post face shield use. In comparison between safety goggles and face shield, safety goggles affected NITBUT to a greater extent than face shields. In addition, our data revealed that safety goggles and face shield wear can cause tear film disruption. Previous research has argued that the impact of swimming goggles wear on different ocular parameters is due to the tension transmitted by the goggle headband which compresses orbital tissue and vasculature [15,16]. Evidence suggests that the major causes of an increased instability may be related to the quality of the "tear binding surface" and the efficacy of the eyelids during blinking.[17] the compression elicited by the swimming goggles headband on the eyelid and

orbit could affect the blinking pattern, inducing an increased surface tension and higher evaporation and de-wetting.[18]

It has been hypothesized the exhaled carbon dioxide has a temperature of 36-37° C which escapes through the upper gap of mask which affects the tear film stability by evaporating the tear film[19]. A similar hypothesis could be considered in the face shield as it creates a closed environment for the user from the head to the chin in which the carbon dioxide being trapped can lead to increase evaporation of tear film. Additionally, it is plausible to expect that safety goggles and face shield wear could cause a mechanical effect on the ocular structures, which may affect, tear production or drainage. There should be a study which can explain more about the possible causes for the changes in tear film parameters due to safety goggles and face shields. There are no previous studies on safety goggles and face shields that have investigated the ocular physiology responses, and thus the lack of previous evidence does not allow us to formulate any hypothesis in this regard.

CONCLUSION

Safety goggles and face shields have been recently used by many healthcare workers and professionals. These equipment's can lead to decreased NITBUT and TMH values leading to tear film disruption and on the comparison, safety goggles effects more than face shields. Eye practitioners have to keep in mind that the use of these equipment's can cause a decrease tear film quality and quantity both which may cause ocular surface dryness.

Conflict of Interest

The authors declare that they don't have any conflict of interests.

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