EFFECT OF MOBILE PHONE ON INTRA-OCULAR PRESSURE IN MOBILE PHONE USERS- A PRELIMINARY REPORT.

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ABSTRACT:

Background& objectives: In the present era, mobile phones are essential companion in one's daily life and they act as hand held computers. Due to the increasing utilization of mobile phones in this COVID -19 pandemic, ophthalmic problems are increasing. Overuse of mobile phone (MP) is reported to be associated with redness of eyes, lacrimation, headache, itching in the eyes, eye strain, ocular discomfort, dry eyes, diplopia, blurring of vision etc. But currently very little information is available about the effects of acute exposure of MP on intra-ocular pressure (IOP), therefore it was decided to investigate the effect of acute exposure of MP on IOP in MP users**.**

Methods: The present study was conducted in 30 subjects of either sex in the age group of 18 to 40 years using MP for 5 years or more with per day exposure of at least 30 minutes or more with normal near vision. Subjects with history of eye or ear infection, trauma, surgery, retinopathy, sudden or gradual loss of vision, diabetes, hypertension, exophthalmos, drug administration and drug allergy were excluded. IOP was recorded in MP users before and after 10 minutes of exposure to mobile phones by applanation tonometry. For exposure to MP, subject was asked to read fixed sample text for ten minutes with their habitual posture in day light from MP (GSM, Samsung Galaxy 70 Electronics Co. Ltd.) Same phone was used for whole of the study. The distance between MP and eye and the posture of head was kept constant. Statistical analysis was done by statistic package SPSS 20 using paired t test. A value of $p<0.05$ was considered significant.

Results: Study was carried out in 30 subjects (24 males and 6 females) who were using MP for the last 5-9 years with a daily exposure of more than 30 minutes. Duration of per call from MP varied from 10 to 30 minutes. There was statistically significant increase (<0.01) in IOP from 16.77 ± 3.25 mm Hg to 17.8 ± 2.76 mm Hg in right eye and 16 .75 ± 2.73 mmHg to 18.38± 2.96 mm Hg in left eye after exposure to MP.

Interpretation and conclusion: There was small but significant increase in intra-ocular pressure on exposure to MP in healthy subjects, who were already using the MP.

Key words: Mobile phone, Intra-ocular pressure, Ocular symptoms.

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Introduction:

Invention of varieties of mobile phones is one of the historical developments in wireless technology. Indispensable dependency on mobile phone (MP) has increased at an alarming pace due to spread of COVID-19 pandemic and subsequent imposition of long durations of repeated lock downs. Recently it is reported that >50% and >10% smart phone users

use internet for >30 min and 4 hours daily respectively[1]. Users spend > 20 hours weekly on internet and text messages ; and social networking services indicate that persons use MP in their communication, recreation, work from home, online classes and so on [2]. Use of MP requires closed focused vision[3].

Use of MP affects visual evoked potential (VEP) [4] and EEG [5]. It is reported that when considerable amount of time is devoted on electronic devices, frequency and magnitude of ophthalmic symptoms i.e., redness of eyes, lacrimation, headache, itching in the eyes are increased[6]. Over use of MP also results in eye strain, diplopia, dry eyes and blurring of vision[7, 8]. A sensation of increased intra-ocular pressure (IOP) is also reported after prolonged use of smartphone[9]. Since there are too many complaints after prolonged use of MP and currently there is dearth of literature showing the effects of acute exposure of mobile phones on IOP, therefore it was thought to be the need of the hour to find out the effect of mobile phone on intra-ocular pressure.

Material and Methods:

The present study was conducted in 30 subjects of either sex in the age group of 18 to 40 years using mobile phones for 5 years or more with per day exposure of 30 minutes or more with normal near vision.

Subjects with history of any eye pathology, surgery, trauma, any ear problem, diabetes, hypertension, any drug administration and drug allergy were **excluded. If subjects wearing glasses, they view MP with their habitual refractive corrective correction. Study was cleared from institutional ethical committee.**

Methodology:

The whole procedure was explained, written consent was taken and the anthropometric and vital parameters were recorded. IOP was recorded from both eyes before and after 10 minutes of exposure to mobile phones[4] by way of using applanation tonometry[10].

Applanation tonometry is the gold standard method for measuring intra-ocular pressure. It requires tonometer, hand held applanation prism, fluorescein strips and clean cotton wool or gauze swabs. It was ensured that the prism is disinfected with isopropyl alcohol70% or sodium hypochlorite 1%. The graduations were checked and the calibrated dial of the tonometer was set at 10 mmHg[10].

After recording of IOP at rest, subject was asked to read a fixed sample of text with black color on white background (12 font size, single spaced) for 10 minutes with their habitual posture in day light from mobile phone (GSM, Samsung Galaxy 70 Electronics Co. Ltd.), and again IOP was recorded using the same mobile phone. The same phone was used till the completion of whole of the study. The distance between MP and eyes and the head posture was kept constant. IOP was measured by Ophthalmologist of Regional Institute of Ophthalmology (RIO) in their outpatient department. The IOP was obtained by contact of tip of probe with central cornea without any eye lid manipulation. Statistical analysis was done by statistic package SPSS 20 using paired t test. A value of < 0.05 was considered significant.

Results:

Study was carried out in 30 subjects (24 males and 6 females) with mean age of 26.6 ± 6.01 years, mean weight of 63.13 ± 11.48 kg and mean height of 165.75 ± 8.62 cm. Subjects were using MP for the last 5-9 years and per day exposure was more than 30 minutes. Duration of per call from MP varied from 10 to 30 minutes. There was statistically significant increase (<0.01) in IOP from 16.77 ± 3.25 mm Hg to 17.8 ± 2.76 mm Hg in right eye after exposure to mobile phone.The IOP in left eye was 16 .75 ± 2.73 mmHg before and 18.38± 2.96 mm Hg after exposure to MP, and this increase was significant (<0.01) (Table1).

Table 1: Comparison of intra-ocular pressure (mm Hg) before and after exposure to mobile phone.

	Before exposure to mobile phone.	After exposure to mobile phone.	p value
Right Eye	16.77±3.25	17.8±2.76	<0.01
Left Eye	16.75±2.73	18.38±2.96	<0.01

p value: <0.01= significant

Discussion:

Eye problems after prolonged use of MP are termed as "computer vision syndrome"[11]. A sensation of an increased intra-ocular pressure is also complained by MP users when MP is used for long time[9]. In our study the normal IOP is 16.77 and 16.75 mm Hg in right and left eye respectively. Although it is within limit, as normal IOP is from 10-20 mmHg in both sexes and is maintained throughout life[3], but it is towards higher side because study is performed in chronic MP users. There occurs a small but significant (<0.01) rise in IOP in both the eyes after the use of MP (acute effect) in this study. It is in accordance with Lee and Kim 2019 who also described the small but significant increase in IOP 5, 10, and 30 minutes after viewing the movie on smartphone in 158 eyes[9]. It is reported that four hours computer work increases IOP even in healthy young adults[3]. Similarly Ha and colleagues found that working on smartphone increases IOP both in day light and low light[12]. The change in the ocular dynamics with use of MP is not clear. It may be associated with excessive use of accommodation and convergence, required for near work on small screen and for small letters[13, 14]. It is stated that with accommodation, there occurs thickening of lens, increase in iris curvature[15] andthus decrease in anterior chamber depth (ACD) of eye results in disturbance in out flow of aqueous humor leading to increase in IOP [13,14.] Accommodation causes significant increase in IOP in eyes with progressive myopia[13]. Increase in IOP occurs more in older people compare to younger eyes[14]. Although present study is carried out in younger subjects, even then there occurred small but significant increase in IOP. It is not only decrease ACD, but larger ACD also contributes to MP induced increase in IOP[9]. According to them visual field (VF) constriction is associated with use of accommodation, thus increase in IOP. Coleman et al revealed that there occurs rise in 2-4 mm of Hg in IOP with near focus with subsequent small decrease in pressure [16]. It is said that to view the object clearly on small screen, eyes need to keep changing focus to maintain clear image[17]. On the other hand, no significant change in IOP was noted in two eyes before and after work shift[18].

Another factor is said to be responsible for rise in IOP is the external ocular muscle (EOM)contractions[19].Levoversion is associated with 5-10 mmHg sustained rise in IOP. While reading and viewing on MP, scrolling is required which necessitate ocular motion and thus EOM contractions and rise in IOP [16.]

Prolonged use of MP is also associated with dry eyes (asthenopia)[12, 20, 21]. When we observe the digital screen, blink rate is reduced[22, 23, 24]. Incomplete blinking also occurs during the use of electronic device[25]. Normally blink rate in humans is 15 times/minute. Blinking reflex is also affected in MP users[26]. This results in dry eye leading not only ocular discomfort but also rise in IOP. Similarly, percentage of asthenopic symptoms is more with work on computer screen compared to reading on hard copy[27]. Prabhas et al revealed that e-book reading affects tear film instability and significant increase in burning sensation and tearing compare to print-book reading[28]. Since cornea is rich with free nerve endings, branches of Trigeminal nerve, dry eye will cause irritation of these nerve endings[29]. It is demonstrated by Perkins that stimulation of Trigeminal nerve in rabbits causes increase in IOP in ipsilateral eye[30]. Contrary to this, Pas –Wyroslak told that corneal surface temperature increases, which improves aqueous outflow and fall in IOP after near work[31].

To view the MP, neck –flexion posture is required, because screen of MP is not at our eye level and more so, it is small screen[32]which necessitate flexion of neck 33-45 degree from vertical position[2]. It is demonstrated that neck –flexion position will result in increase in IOP compare to neck –extension or neutral posture[2, 33, 34].

It is stated that use of Smartphone induces psycho-physiological stress[12]or neuropsychiatric problems[35]as electromagnetic waves (EMW) are emitted from it. Along with this, technical use of it, particularly in aged persons and also continuous perception of new information produces stress. This psycho-physiological stress stimulates sympathetic

nervous system, which causes rise in nor-adrenaline release, may thus increase in IOP[36, 37]. Other factor contributing to rise in IOP with use of MP is low ambient illumination (although present study was conducted in day light), but most of the persons use the MP in night, on bed. Dark environment is associated with increased pupil diameter and thus thickened iris, results in early visual fatigue [38,39].

The increase in IOP noted in present study occurred in both the eyes. But rise is more in left eye compared to right eye. This is in accordance with Quidsiya et al, 2017 who demonstrated that rise in IOP is more in left eye compare to right eye. He stated that right eye is dominant eye in most of the persons, and it may be due to direction of script from left to right in English language[3].

IOP also shows circadian rhythm[40]. So to exclude this factor, we conducted the study in day time keeping recording of IOP at fixed hours, to avoid the effect of diurnal variation.

Proximity of MP to human eyes also makes the person susceptible for the effect of radiofrequency (RF) electromagnetic fields (EMF)emitted from MP. But it is reported that no statistically significant difference in visual discrimination threshold (VDThr) is noted when data for RF exposure is compared with those for sham exposure[41]. On the other hand, chronic microwave radiation leads the formation of cataract[42].

Fluctuation and even small rise IOP is of clinical significance, particularly in young subjects, who uses the MP hours together, as it is the need of the hour also, due torapidly occurring digitalization in all fields, which may lead to glaucoma and ultimately slow and progressive loss of vision, which may cause loss of productivity and economy of person. Although MP is necessary to use, but we should make the public aware about its ill effects and take appropriate precautions to prevent rise in IOP and development of glaucoma. It should be kept in mind that even a small and short-term change in IOP could greatly affects the progress and prognosis of glaucoma[43, 44]. Even in normal tension glaucoma, fluctuation in IOP plays important role in its progress[44]. Fluctuation in IOP damages the ganglion cells of retina and optic nerve fibers which results in deepening of physiological cup or pathological cupping of optic disc along with damage to part to retina, which may appear as scotomas in visual fields, and may progress to blindness[3]. Therefore when using the digital screen for long time we should follow the rule of 20/20/20.

Conclusion: Exposure to MP causes small but significant increase in intra-ocular pressure in both the eyes in young healthy subjects, who already were the chronic MP users.

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