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THE INFLUENCE OF HANDHELD MOBILE PHONES ON HUMAN PAROTID GLAND SALIVARY SECRETION RATE AND PROTEIN CONCENTRATION

Dr. Abheet Assistant Professor, Department of dentistry, Madhubani Medical College, Madhubani, Bihar

Dr. Mohammad Zakiuddin* Professor & HOD, department of physiology, Madhubani Medical College, Madhubani, Bihar *Corresponding Author

ABSTRACT **Background:** Handheld mobile phones (MPHs) have become a cultural' accessory device, no less so than a wrist watch. Nevertheless, the use of MPHs has given rise to great concern because of possible adverse health effects from exposure to the radiofrequency radiation (RFR) emitted by the device. **Aims & Objective:** To compare the parotid salivary secretion rate and protein concentration between dominant and less dominant sides parotid gland. **Methods And Materials:** The study was approved by the Institutional ethical Research Committee and written informed consent was obtained from all participants. The study comprised 50 healthy volunteers (25 men and 25 women), mean age 28 ± 3.3 years, range 20–35 years from September 2022 to August 2023. The saliva secretion rate of both parotid glands was measured simultaneously between 8 and 12 AM using a modification of the Carlson–Crittenden collector. Salivary flow was stimulated with 2% citric acid, which was applied with a cotton swab on the tongue and oral part of the lower lip bilaterally at 30 s intervals for 2 min. Saliva was collected for another 3 min, adding to a total collection time of 5 min. Samples were kept on ice during and after saliva collection. Thereafter, the samples were centrifuged at 7000 g-9000 g (25–150 kDa) for 20 min at 4oC. The supernatant was collected and protein concentration determined according to the procedure described by Bradford (Bio-Rad, Hercules, CA, USA). **Results:** A total of 38 participants (76%) used the right ear more frequently and the remaining the left ear. Saliva secretion rate in subjects whose dominant side was the right, the overall mean stimulated parotid flow rate measured was almost 1.5-fold higher than the rate from the left parotid gland. Overall, a 2.54-fold increase in salivary secretion rate was found between the dominant and non-dominant sides.

KEYWORDS : Handheld mobile phones, Parotid gland and Carlson–Crittenden collector

INTRODUCTION:

The mobile technology has emerged into our world rapidly and has caused many changes in our lifestyles. Statistics show that 79% of the US population and 90% of European and Asian teens own an MPH. MPHs have caused great concern because of the possible adverse health effects from exposure to RFR emitted by the device, which operates as a receiver and a transmitter. Its operation is based on electromagnetic waves, specifically RF waves and microwaves. The transmission is performed through a range of frequencies between 800 and 2200 MHz. The radiation emitted is non-ionizing and the rate of exposure is defined as the rate of RF energy absorption in a weight or mass unit of a biologic body. It is measured by SAR (specific absorption rate) in Watts kg)1 or mW g)1 . The possibility of side effects associated with the electromagnetic waves emitted from mobile phones is a controversial issue. In humans, the parotid glands are the largest salivary glands, situated in front of the ear and behind the ramus of the mandible in proximity to the skin of the face. Saliva is mainly composed of water (99%); however, the smaller component but still crucial for many tasks is the bioactive molecules secreted in saliva. The parotid glands secrete so-called serous saliva and are mainly activated after stimulation resulting from smell, taste, and mastication activity. In this study, we compared the parotid salivary secretion rate and protein concentration between dominant and less dominant sides of subjects from a healthy population who use MPHs.

AIMS AND OBJECTIVE:

To compare the parotid salivary secretion rate and protein concentration between dominant and less dominant sides parotid gland.

MATERIAL AND METHODS:

The study was approved by the Institutional ethical Research Committee and written informed consent was obtained from all participants.

SUBJECTS:

The study comprised 50 healthy volunteers (25 men and 25 women), mean age 28 ± 3.3 years, range 20–35 years.

Inclusion Criteria:

1. Age between 20 to 35 years 2. 50 healthy volunteers

Exclusion criteria: included

1. Drug abuse 2. Chronic alcohol or smoking abuse 3. Systemic chronic diseases 4. Past head or neck injury 5. Trauma 6. Pregnancy 7. No preferable custom to side holding the MPH 8. No complaint of xerostomia (dry mouth sensation).

All subjects used MPHs that do not exceed the permitted SAR limits. Study protocol Volunteers were asked not to eat, drink, or brush their teeth an hour before saliva collection. After filling in a questionnaire regarding MPH lifestyle, the saliva secretion rate of both parotid glands was measured simultaneously between 8 and 12 AM using a modification of the Carlson–Crittenden collector

Fig:-1 Modified Carlson-Crittenden cup

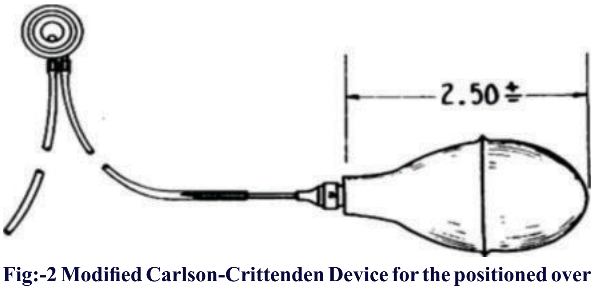

Fig:-2 Modified Carlson-Crittenden Device for the positioned over parotid duct opening. Collection of Parotid Fluid

Prior to placement of the cup, the buccal mucosa was dried with gauze and Stensen's ducts were slightly squeezed to locate the ducts' orifices. To maintain an equal force of suction from both sides, a calibrated stopper was placed on the syringe connected to the tube. Salivary flow was stimulated with 2% citric acid, which was applied with a cotton swab on the tongue and oral part of the lower lip bilaterally at 30 s intervals for 2 min. Saliva was collected for another 3 min, adding to a total collection time of 5 min. Samples were kept on ice during and after saliva collection. Thereafter, the samples were centrifuged at 7000 g-9000 g (25–150 kDa) for 20 min at 4°C. The supernatant was collected and protein concentration determined according to the procedure described by Bradford (Bio-Rad, Hercules, CA, USA).

Study Duration:- From September 2022 to August 2023

The variable of daily use of MPH without a speaker was calculated by multiplying the total daily use of MPH and the percent of MPH use without a speaker. The variables of salivary flow and the amount of protein in 1 ml of saliva were assessed as a ratio between the dominant and non-dominant side values. The correlations between the variables of saliva secretion and protein per ml of saliva and the variables of MPH use and total daily time of MPH use were assessed by means of Pearson' correlation tests. A comparison of variable values between two subgroups of participants was obtained using the one-way analysis of variance'

Statistical Analysis:

Statistical analysis Mean values, median standard deviation (SDM), and standard error of the mean were calculated. An incidence distribution comparison of categorical variables was carried out using the chi-squared test. All statistical tests were analyzed to a significance level of 0.05

RESULT:

A total of 50 healthy individuals (25 men and 25 women, mean age 28 ± 3.3 years, range 20–35 years.) participated in the study, with a mean of 7 years of MPH use More than half reported using MPH at least five times a day, with only 2% using MPH twice a day. Almost half of the participants used hands-free accessories. A total of 38 participants (76%) used the right ear more frequently and the remaining the left ear. Saliva secretion rate In subjects whose dominant side was the right, the overall mean stimulated parotid flow rate measured was almost 1.5-fold higher than the rate from the left parotid gland ($P = 0.001$, Table 2). In subjects whose dominant side was left, the overall stimulated parotid flow rate measured was almost identical to that of the right parotid gland, respectively. Overall, a 2.54-fold increase in salivary secretion rate was found between the dominant and non-dominant sides. A middling correlation strength was found between the dominant and non-dominant sides and the number of years of MPH use ($P = 0.003$). No correlation was found between daily MPH time use and the saliva secretion rate ($r = 0.20$). Protein concentrations. The mean protein concentration in subjects whose dominant side was right showed significantly higher concentrations in saliva secreted in the left gland ($P = 0.006$). On the other hand, no significant differences were found between the two parotid glands in subjects whose dominant side was left. Overall, the total protein per ml concentration ($n = 50$) was slightly higher in the dominant side by 1.2-folds, with no significant difference. No correlation was found between the number of years of MPH use and protein concentration ($r = 0.08$) or between daily MPH time use and protein concentration ($r = 0.03$).

DISCUSSION:

The objective of this study was to examine whether the use of MPH influences the parotid glands' 2 fundamental functions; rate of saliva secretion and protein concentration in saliva. The main outcome was a 2.54- fold increase in the salivary secretion rate between the dominant and non-dominant sides. As mastication forces are superior on the dominant side of the cranio-facial complex, higher secretion rates will result from the parotid gland on the equivalent side because of the masticatory-salivary reflex. Conversely, Burlage et al previously found no significant difference in the overall mean stimulated parotid flow rate measured in healthy subjects (0.33 ± 0.13 ml min)1 and 0.33 ± 0.14 ml min)1 for the left and right parotid glands, respectively, Burlage et al, 2005

Salivary secretion is regulated by the autonomic parasympathetic and sympathetic nervous system. Collectively, both arms are responsible for secretion, whereas the parasympathetic pathway induces more waterish saliva and the sympathetic one generates the protein secretory component. Interestingly, in contrast to higher salivary secretion rates in the dominant side, decreased protein concentration was measured from the right dominant side compared with that from the left non-dominant MPH side. This divergent effect on fluid vs protein concentrations in this study may be attributed to different effects of the MPH use on parasympathetic and sympathetic pathways. An intriguing observation was recently reported on the influence of the MPH on heart rate variability parameters in healthy volunteers (Andrzejak et al, 2008). This study showed that the parasympathetic tone increased while the sympathetic tone decreased during MPH use. The authors further suggested that the electromagnetic field generated by MPH may affect the autonomic nervous system by modulating the function of the circulatory system (Andrzejak et al, 2008). There are two known possible effects of the mobile energy on the human body – thermal and non-thermal. The heating of biological tissue is a result of microwave energy absorption by the water content of the tissues (Hyland, 2000). Some parts of the body are more vulnerable to a small temperature rise, such as the testes and eyes. Moreover, mobile radiation can modify cutaneous blood flow (Monfrecola et al, 2003). Symptoms reported by MPH users include a feeling of warmth on the ear and behind it, and a feeling of burning and tingling on the face (Sandstrom et al, 2001). Monfrecola et al found an elevation in skin perfusion when the MPH was switched on and in the proximity of the skin. Consequently, the repetitive use of the MPHs causes an elevation in skin temperature and induces an increase in the perfusion of the tissue to cool it down. Furthermore, MPH generates heat in adjacent tissues, no greater than 0.1°C for the highestpowered models (Van Leeuwen et al, 1999). Nevertheless, continuous use results in a warm sensation on the skin adjacent to the MPH's location during transmission (Sandstrom et al, 2001; Straume et al, 2005). In our study, 44% of the participants reported a warm sensation on their cheek, 10% on their ear, and 6% on both areas. We hypothesized that the enriched capillary bed adjacent to the parotid glands may result in an increase of perfusion because of blood vessel propagation over an extensive time of exposure to heat, leading to an increase in the salivary rate flow. Another rationale for increased salivary flow from the dominant MPH side because of thermal effect may be attributed to secretory parenchymal tissue expansion. It has been shown previously that heat acclimation of rats for up to 28 days changes the ratio of weight to size in the salivary glands (Horowitz and Soskolne, 1978; David et al, 2008). Further studies should be conducted to assess the parenchymal volume of parotid glands to test this assumption.

CONCLUSION:

In conclusion, we found changes in the salivary secretion and protein concentration because of MPH use. More studies should focus on the effect of MPH use in the long run on the normal function of parotid glands, by, for instance, analyzing the protein profile of the affected glands.

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