Are We Telephoning Ourselves to an Upcoming Danger?

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Abstract

Aims and objectives: To evaluate the effect of mobile phones on salivary flow rate and protein concentration in saliva of parotid gland, comparing on dominant and non-dominant side of mobile phone users.

Material and methods: Parotid saliva is collected simultaneously from both the glands in 50 healthy volunteers, using a sialographic cannula and stimulated using lemon juice.

Results: Salivary secretion rate was significantly less on dominant side of mobile phone usage. But protien concentration was no such significance on comparison with dominant and non-dominant side.

Conclusion: We are concluding that there is change in the functional activities of parotid gland for heavy mobile phone users. Saliva secretion rate of parotid gland on dominant side of mobile usage is less when compared to non-dominat side. So, over usage of mobile phones is hazardous, it should enlighten the society.

Key Words: Mobile phones, Radiation, Saliva, Parotid gland, Dominant side, Non-dominant side

Introduction

Every day, we're swimming in a sea of electromagnetic radiation (EMR) produced by electrical appliances, power lines, wiring in buildings, and a slew of other technologies that are part of modern life. From the dishwasher and microwave oven in the kitchen and the clock radio next to your bed, to the mobile phone you hold to your ear - sometimes for hours each day - exposure to EMR is growing and becoming a serious health threat. The popularity of mobile phones is increased and associated with the hazardous effects of mobile phone radiation (radiofrequency electromagnetic waves; RF-EMW) exposure on human health [1].

Mobile phones itself acts as a transmitter and receiver, their radiofrequency (RF) signals ranges in between 800 MHz and 2200 MHz, which fall in the radio waves and microwaves part of the electromagnetic spectrum [2]. The first cellular systems were based on analogue technologies that were progressively replaced by digital systems. RF radiation at higher levels can lead to heating by inducing small electric currents and causing the molecular movement to increase [3]. However, a classic mobile phone operates at a power output of 0.25 W, which results in a specific energy absorption rate of about 1.5 W/kg and associated with very low rise in brain temperature (maximum 0.1 °C) [3,4].

Previous studies had a focus on the mobile phone use and risk of brain tumors, because of increased exposure to electromagnetic fields near the temporal region of the brain where the antenna of the mobile phone is in approximate [5]. Here another organ of interest is the parotid gland, the largest salivary glands in the human body, which is located over the jaw bone in front of the ear. This gland is likely to be exposed to radiation during mobile phone use as the handset is held close to the ear.

Considering the past literatures about the effects of mobile phone radiation are the source for many changes in parotid gland, it may be physiologic, structural, functional, or even carcinogenic changes [6]. However, there is still an unclear idea about the mobile radiation effects on human body and on adjacent parotid gland.

We conducted a study to evaluate the effect of mobile phones on salivary flow rate and protein concentration in saliva of parotid gland, comparing on dominant and non-dominant side of mobile phone users.

Materials and Methods

The study was approved by the Institutional Research Ethics Committee and written informed consent was obtained from all participants. The study was conducted in 50 healthy volunteers (25 males, 25 females) in St. Joseph Dental College and Hospital, Andhra Pradesh. Students who were voluntarily willing to participate in the study and who uses mobile phone at least 2 hours in a day (GSM mobile phones) were selected for the study.

Volunteers using any mobile accessories like headset or bluetooth devices, chronic alcoholics or smokers, systemic chronic diseases, previous trauma to orofacial structures, with history or presence of salivary gland disorders, any medication causing xerostomia, pregnant women, not sure about the side they use the mobile phone.

Armamentarium *(Figure 1)*

1. Sialographic cannula
2. Lacrimal probe
3. Surgical gloves
4. Calibrated tubes
5. Lemon juice
6. Stopwatch
7. Syringe

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Questionnaire regarding the usage of mobile phone were filled. Volunteers were asked not to eat drink half an hour before the saliva collection. The saliva secretion rate of both parotid glands was measured. The saliva was collected using sialographic cannula which is inserted into the Stenson's duct *(Figure 2)* passively between 2 to 4 pm simultaneously *(Figure 3)*. The salivary flow was then stimulated with 2 drops of lemon juice, which was applied with a cotton swab on the tip of the tongue. Stimulated saliva was collected for a period of 5 min in a calibrated tube.

Figure 1. *Armamentarium.*

Figure 2. *Sialographic cannula inserted into Stenson's duct.*

Figure 3. *Simultaneous collection of saliva.*

Thereafter, the samples were measured and they were subjected for protein evaluation using Biuret End point method of protein estimation. Protein forms a colored complex with cupric ions in alkaline medium. Based on this principle, salivary protein estimation was done by mixing undiluted saliva with the reagent (45 g of Rochelle salt and 15 g of copper sulfate in 400 mL of 0.2 N sodium hydroxide. Five grams of potassium iodide was added to make up to 1 L with 0.2 N sodium hydroxide) and measuring the colored product using a photoelectric colorimeter at a wavelength of 546 nm. Standard solution of 6 g of bovine albumin dissolved in 100 mL of normal saline containing 0.1 g/dL sodium azide was used. The readings were recorded in ml and g/dl consequently [7].

Results

A total of 50 healthy individuals (25 males and 25 females, mean age 22.77 years) participated in the study who are students of our college and uses mobile phone at least 2 hours in a day (GSM mobile phones). The saliva was collected using sialographic cannula which was inserted into the stenson's duct passively, stimulated by placing lemon juice and collected for a period of 5 min. The duration of mobile phone usage ranged from 2 to 4 hrs in a day. The mean of mobile phone use in a day was 3.29 hrs. A total of 28 participants (56%) used the right ear more frequently which was their dominant side and the remaining use left ears, their dominant side.

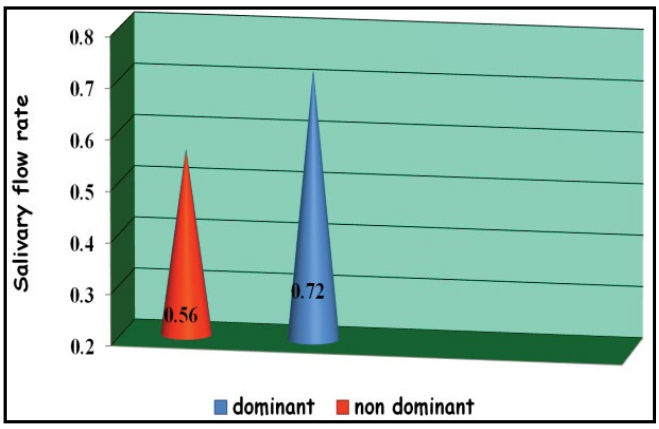
Statistical analysis

Mean values and mean differences were calculated. Comparison of mean values of dominant and non dominant side was performed using T tests. The correlations between the variables of saliva secretion and protein content of saliva were assessed by means of Pearson' correlation tests. All statistical tests were analyzed to a significance level of 0.05.

Saliva secretion rate

The mean value on dominant side was 0.56 ± 0.55 and on non-dominant side was 0.72 ± 0.66. The mean difference was 0.16 ± 0.11 and p-value was found to be 0.021, which was statistically significant *(Graph 1)*.

In males the mean of salivary flow rate on dominant side was 0.61 ± 0.60, and on non-dominant side was 0.80 ± 0.75. The mean difference was 0.19 ± 0.15; p value was 0.086



Graph 1. *Salivary flow rate in dominant and non-dominant side.*

which was statistically not significant *(Table 1)*.

In females the mean of salivary flow rate on dominant side was 0.50 ± 0.50, and on non-dominant side was 0.64 ± 0.56. The mean difference was 0.14 ± 0.06; p value was 0.136 which was statistically not significant *(Table 2)*.

On comparing male and females, the salivary flow rate is more in males with mean of 1.38 in males and 1.14 in females; p value was 0.00027 which was statistically significant; Pearson's correlation was positive (0.0338) *(Graph 2)*.

Protein concentration

The mean value on dominant side was 1.74 ± 0.43 and on non-dominant side was 1.78 ± 0.42. The mean difference was 0.04 ± 0.01and p-value was 0.453, which was statistically not significant *(Graph 3)*.

In males the mean of protein concentration on dominant side was 1.82 ± 0.44, and on non dominant side was 1.79 ± 0.38. The mean difference was 0.03 ± 0.06; p value was 0.76 which was statistically not significant *(Table 3)*.

In females the mean of protein concentration on dominant side was 1.66 ± 0.41, and on non dominant side was 1.77 ± 0.47. The mean difference was 0.11 ± 0.06; p value was 0.132 which was statistically not significant *(Table 4)*.

On comparing male and females the protein concentration is more in males with mean of 3.6 in males and 3.4 in females; p value was 0.00024 which was stastically significant; Pearson's correlation was negative (-0.212) *(Graph 4)*.

Discussion

Salivary secretion is regulated by the autonomic parasympathetic and sympathetic nervous system. Parasympathetic stimulation results in increased watery (less viscous) saliva, whereas sympathetic stimulation results in mucoid (more viscous) and protein component of saliva secretions. Here in our study lower salivary secretions and less protein concentration on dominant side of mobile users when compared to non-dominant side. Andrzejak et al. (2008) and Awdah Al-hazimi (2011) showed that the tone of the parasympathetic system measured indirectly by analysis of heart rate variability was increased while sympathetic tone was lowered during the call with use of a mobile phone. It was shown that the call with a mobile phone may change the autonomic balance in healthy subjects [8,9].

Two emissions from the mobile phones, namely, heat generated and radiofrequency radiation, can be possibly implicated for causing changes in human body [2,6]. Horowitz and Soskolne (1978) stated that heat application in rats changes the weight and size in the salivary glands, indicating that heat can bring structural changes in salivary glands. We assume that thermal effects of mobile phones are the principle factor for causing the ipsilateral decrease in salivary secretion [10].

The acinar cells first secrete isotonic primary saliva and then the striated duct cells actively extract ions to render the saliva progressively more hypotonic as it passes down the ducts towards the mouth. We hypothesized that reduced salivary flow rate may be due to increased radiation effect over the parotid due to prolonged usage of mobile phones. Further it may cause reduction in activity of acinar cellsas they are the dominant cells in serous secretion. This was supported by Horowitz and Soskolne (1978); they stated that there was an initial hyperplasia of the acini cells followed by hypertrophy of the acinar cells [10]. This is in agreement with our study as we considered the long term mobile phone users.

Van Leeuwen et al. (1999) stated that even the highest powered models of mobile phones generate only 0.1°C heat [4]. However, frequent use of mobile phone results in a warm sensation on the skin adjacent to the mobile phone's location during transmission [11-13]. 32 participants in our study experienced the warm sensation around the ear on prolonged usage of mobile phones. There was increased risk observed for individuals with longer duration of speaking in mobile phones causing warmth sensation [9]. In our study we considered individuals who use mobile phones for more than 2 hours of duration. 27 individuals used mobile phone upto 3 hours and 23 individuals for more than 3 hours in a day.

The weak EMR on human results in absorption into the biological field patterns, cause accumulation of energy and information into the body fluid, change in the functional activities of cell which finally results into disease [14]. Monfrecola et al. described that cell phone radiation can alter cutaneous blood flow and elevation in skin perfusion when the gadget was near to skin [15].

In our study, we found changes in salivary flow rate of parotid gland which was in accordance with Goldwein O, Aframian DJ .Stuti Bhargava also stated that functional and volumetric changes induced in parotid glands are associated with excessive mobile phone use [2,6].

Inoue et al. stated that decrease salivary flow in females

Table 1.*Comparison of salivary flow rate between dominant and non-dominant side in male individuals.*

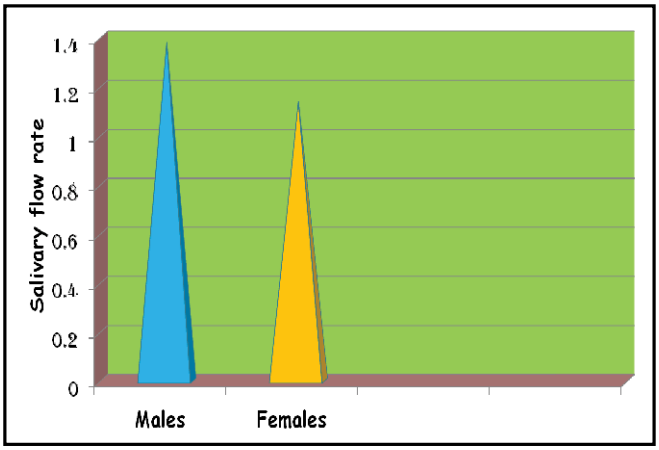
Salivary flow rate (ml) In Male	Sample size	MEAN ± SD	Mean difference MEAN ± SD	t value	P value
Dominant side	25	0.61 ± 0.60	0.19 ± 0.15	-1.790	0.086 Not significant
Non dominant side	25	0.80 ± 0.75			

Statistical Analysis: Paired t test. Statistically significant if P<0.05

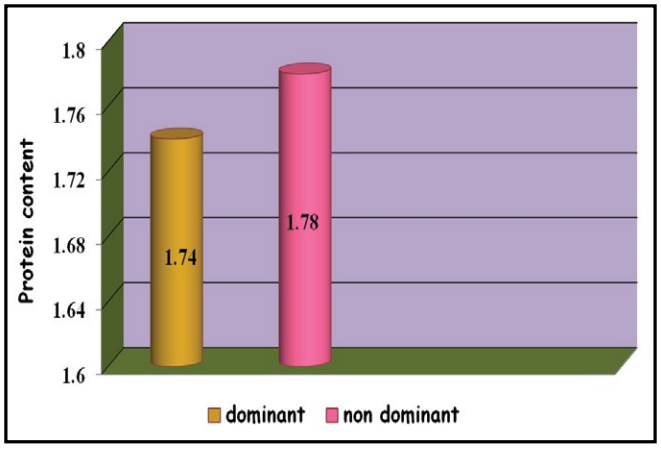
Table 2.*Comparison of salivary flow rate between dominant and non-dominant side in female individuals.*

Salivary flow rate (ml) In Female	Sample size	MEAN ± SD	Mean difference MEAN ± SD	t value	P value
Dominant side	25	0.50 ± 0.50	0.14 ± 0.06	-1.542	0.136 NS
Non dominant side	25	0.64 ± 0.56			

Statistical Analysis: Paired t test. Statistically significant if P<0.05



Graph 2. *Salivary flow rate in males and females.*



Graph 3*. Protein concentration in dominant and non-dominant side.*

Table 3.*Comparison of protein content between dominant and non-dominant side in male individuals.*

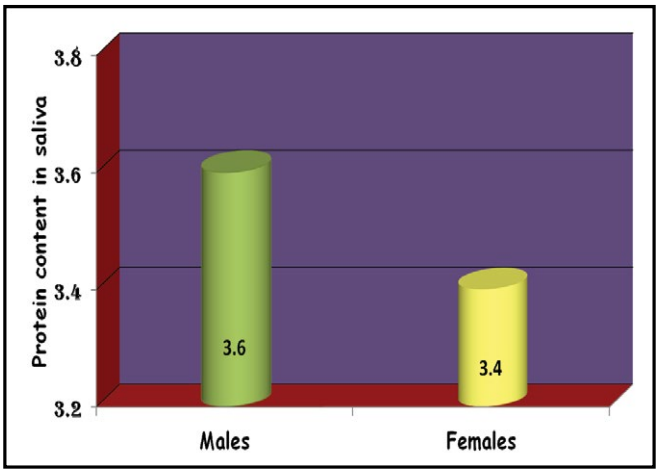
Protein content (mg/dl) In Male	Sample size	MEAN ± SD	Mean difference MEAN ± SD	t value	P value
Dominant side	25	1.82 ± 0.44	0.03 ± 0.06	0.355	0.76 NS
Non dominant side	25	1.79 ± 0.38			

Statistical Analysis: Paired t test. Statistically significant if P<0.05

Table 4.*Comparison of protein content between dominant and non-dominant side in female individuals.*

Protien content (mg/dl) In Female	Sample size	MEAN ± SD	Mean difference MEAN ± SD	t value	P value
Dominant side	25	1.66 ± 0.41	0.11 ± 0.06	-1.559	0.132 NS
Non dominant side	25	1.77 ± 0.47			

Statistical Analysis: Paired t test. Statistically significant if P<0s.05



Graph 4. *Protein concentration in males and females.*

when compared to males may be due to the smaller gland sizes and the smaller body sizes in females [16]. In our study we found that females have less salivary secretion in comparison with males.

Conclusion

Here, we are concluding that there is change in the functional activities of parotid gland with heavy usage of mobile phone. Furthermore, studies should be conducted in a large scale to know the ignorant effects of mobile phones.

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