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# EVALUATION OF SALIVARY FLOW RATE OF THE PAROTID GLAND UNDER THE EFFECT OF MOBILE RADIATION USING CHROMATOGRAPHY PAPER

**Dr. Sami Faisal Jamdar*[1], Zidan Muead Alanazi[2], Abdullah Mohammad Alhussain[3], Aaminah Fatima Jamdar[4]**

[1]BDS, MDS, (Maxillofacial Surgery), MD (General Medicine), Specialist Maxillofacial Surgeon, Ministry of Health, Hafar Al Batin Central Hospital, Saudi Arabia.
[2]Specialist Oral Maxillofacial Surgeon, King Khalid General Hospital, Ministry of Health, Hafar Al Batin Central Hospital, Saudi Arabia.
[3]BDS General Dentist, Ministry of Health, Hafar Al Batin Central Hospital, Saudi Arabia.
[4]MBBS, Resident Doctor, Hafr Albaten Central Hospital, Ministry of Health, Saudi Arabia.

***Corresponding Author: Dr. Sami Faisal Jamdar**
BDS, MDS, (Maxillofacial Surgery), MD (General Medicine), Specialist Maxillofacial Surgeon, Ministry of health, Hafar Al Batin Central Hospital, Saudi Arabia.

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## ABSTRACT

**Introduction:** The aim of the study was to measure the flow rate of unstimulated parotid saliva among the study volunteers with a history of using hand held mobile phones on dominant and non-dominant side using a simple chromatography filter paper technique based on Iodine Starch colour reaction. **Materials & Methods:** In this study 120 subjects with good health were included. Patients were asked to sit in a quiet room with the head slightly tilted down. The starch iodide loaded chromatic paper was held at the opening of Stenson's Duct for 2 minutes on dominant and non-dominant side, one side at a time basis. After 2 minutes the paper was taken out and the colouring reagent was added drop wise to the wet spots on the paper. **Results:** Out of 120 study group subjects, maximum numbers of subjects (50) were found to have three coloured spots in dominant side, while maximum numbers of subjects (48) were found to have 0coloured spots in non-dominant side. Difference between dominant and non-dominant side was found to be statistically significant. **Discussion & Conclusion:** In this study salivary flow rate was assessed using chromatography paper based on the Iodine starch reaction. Three coloured spots appeared on the paper for patients with decreased salivary flow rate, whereas for healthy subjects with normal flow rate there was one coloured spot or none.

**KEYWORDS:** Parotid gland, Mobile phone, Chromatography paper, salivary flow.

## INTRODUCTION

A variety of medical conditions and medications can alter salivary secretion and composition.

Composition of saliva can be affected by many physiological variables.[1] Salivary flow rate is variable in individuals and in the same individual under various conditions. Presently saliva is used as a diagnostic fluid in various conditions like - autoimmune disorders, hereditary disorders, infectious diseases, endocrine disorders and malignancies.[2]

Saliva plays an important role in teeth maintenance by its antimicrobial action and also in digestion and food perception.[3] During these two last actions, saliva is predominantly released from the parotid glands. During eating, the proportion of parotid saliva in whole saliva can increase from 0% to more than 50%.[4] Such an increase, due to stimulation by mastication and/or taste compounds, has been called the parotid salivary reflex. Consequently, parotid saliva participates largely in bolus formation and digestion, e.g., by the contribution of α-amylase in starch hydrolysis. 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.[5]

Mobile technology has emerged into our world rapidly and has manychanges in our lifestyles. The handheld mobile phone operation is based on electromagnetic waves, in the range of radiofrequency waves and microwaves. The transmission is performed through a range of frequencies between 800 and 2200 MHz's.[6] The proximity of mobile phones during use has given rise to concerns of possible adverse effects resulting from absorption of these radiations by the tissues, adjacent to the area of mobile phone used. The radiation may cause dose dependent adverse effects like sialorrhea, parotid gland tumours and epithelial parotid gland malignancies, auditory canal pathologies and tinnitus.[7]

Parotid gland is the largest salivary gland located in front of ear and behind the ramus of mandible just deep to the superficial fascia and skin of face. The location of Parotid gland makes it more vulnerable to changes resulting from mobile phone heat and radiation.[8] Hence the present study was designed to evaluate the parotid salivary secretion rate and comparing it between dominant side (more frequently used side) and non-dominant side(less frequently used side) of handheld mobile phone users.

Though studies suggesting the effect of hand held mobile phone on salivary flow of parotid gland are available, but the method of collection and measuring the salivary sample is elaborate and technical sensitive requiring some amount of training.[9] The aim of the proposed study is to evaluate the effectiveness of starch iodine chromatic paper, for measuring the parotid salivary flow rate, as the technique is described to be easier, less time consuming and do not involve elaborate laboratory procedure.

## MATERIALS AND METHOD

The flow rate of unstimulated parotid saliva is assessed among the study volunteers with a history of using hand held mobile phones on dominant and non-dominant side using a simple chromatography filter paper technique based on Iodine Starch colour reaction. Salivary flow rate was assessed in individuals who visited Dental College & Hospital. In the present study 120 subjects with good health were included. All the individuals included in the study were well informed about the study and the written informed consent was taken from each individuals.

All the individuals included in study were of more than 18 years and all of them were using mobile phone from more than 2 years. Individuals having xerostomia, under medication the influence salivary secretion, presence of any pathology, those who were fasting for more than 10 days, presence of any alcohol and tobacco habit and those with presence of any psychological disorders were excluded from the study.

All the included individuals were asked to sit in a quiet room. Before the collection of sample the individuals were ask not to intake any beverages and food for 2 hours. Individuals were asked to minimize their movements and specially the swallowing habit to restrict during the sample collection time. The individuals were given questioner related to the lifestyle that includes the mobile phone and the sample secretion for both the parotid glands was done in the morning period.

To assess the salivary secretion, the starch iodide loaded chromatic paper was held for the particular time of 2 mins on dominant and non dominant side at the opening of Stenson's duct. Once the time period was over the paper was taken out and the reagent that is hydrogen peroxide was added to the wet stops on the paper. The wet areas changed to blue colour and were measured to record the salivary flow rate per minute. Then 4µL of the detection reagent solution were spotted at three places on the filter paper using a micro pipette. The filter paper was left overnight in a cool dark room and then stored in a light resistant container until use. Colouring reagent was prepared from a solution of 31% hydrogen peroxide, ethyl alcohol and distilled water in the ratio of 1: 7: 1. Due to the iodine starch reaction, colourless spots immediately turned into dark blue and then to blue within a few minutes. This colour remains stable for 90 minutes. Then the number of blue spots, including partly coloured spots (<50%) were grossly counted as an integer.

## RESULTS

The present research was undertaken to measure the unstimulated salivary flow rate in the 120 study individuals. The aim of the research was to evaluate the effect of starch chromatic paper to measure the parotid salivary flow rate. The minimum age of the individual included was 19 years and maximum age was of 79 years. The maximum numbers of individuals were in age group 30 – 39 years. (Table 1) Owing to the gender wise distribution predominance of male was found as compare to females. Total of 82 males and 68 females were included in the study. Of the total 120 individuals included the study, the maximum number of individuals (50)m had three coloured spots on dominant side, while on non dominant side the maximum number (48) of individuals had 0 colour spots. The difference between the non dominant and dominant was found to be statistically significant with $p<0.05$.

Three coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 112.23 ± 23 µl/ min. Two coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 220.30 ± 31 µl/ min. One coloured spot on the filter paper was obtained for the subjects with salivary flow rate of 380.11 ± 30 µl/ min. difference between the number of coloured spots and the salivary flow rate was found to be highly significant. ($p \leq 0.05$)

**Table 1: Age wise distribution of the individuals included in the study.**

| Age (years) | Number | Percentage |
|---|---|---|
| **19-29** | 13 | 21.6 |
| **30-39** | 19 | 31.6 |
| **40-49** | 12 | 20 |
| **50-59** | 10 | 16.6 |
| **60-69** | 4 | 6.6 |

| | | |
|---|---|---|
| **Above 70** | 2 | 3.3 |
| **Total** | 60 | 100 |

**Table 2: The number of colored spots and resting salivary flow rate in dominant side.**

| Number of spots on chromatography paper | Frequency in dominant side | Mean±SD flow rate (µl/min) | P value |
|---|---|---|---|
| **0** | 11 | 431.09±30 | 0.001* |
| **1** | 13 | 380.11 ± 30 | |
| **2** | 11 | 220.30 ± 31 | |
| **3** | 25 | 112.23 ± 23 | |

**Table 3: The number of colored spots and resting salivary flow rate in non-dominant side.**

| Number of spots on chromatography paper | Frequency in dominant side | Mean±SD flow rate (µl/min) | P value |
|---|---|---|---|
| **0** | 24 | 125.10 ± 40 | 0.1 |
| **1** | 19 | 200.20 ± 34 | |
| **2** | 9 | 366.45 ± 32 | |
| **3** | 8 | 429.20 ± 21 | |

Three coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 429.20 ± 21 µl/ min. Two coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 366.45 ± 32 µl/ min. One coloured spot on the filter paper was obtained for the subjects with salivary flow rate of 200.20 ± 34 µl/ min. difference between the number of coloured spots and the salivary flow rate.was found to be non-significant. (p>0.05)

It was observed that males had higher number of 3 spots on dominant side and highest number of 0 spots on non dominant side, same thing was observed in females too. The mean salivary volume of 298 ul/min was found in males on dominant side and had mean salivary volume of 302 ul/min in non-dominant side. Whereas in the female mean salivary volume of 241 ul/min was found in dominant side and 370 ul/min salivary volume was found in non dominant side. In non dominant side we obtained higher frequency of 0 numbers of spots and higher volume of mean salivary volume.

## DISCUSSION

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 secretary component.[10] 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.[11]

Long duration and proximity of mobile phones to human body during use has given rise to concerns of possible adverse effects resulting from absorption of these emissions by the tissues adjacent to the area of mobile phone handset use.[7] The parotid glands are the largest salivary glands, situated in front of the ear, near the place used by cell phones during calls. This makes parotid glands vulnerable to changes, if any, resulting from mobile phone heat and radiation.[12]

Present study was done to evaluate the effectiveness of starch iodine chromatic paper, for measuring the parotid salivary flow rate. Estimation of salivary flow is based on the difference in movement between potassium iodide and starch in the paper chromatography and the colour reaction of iodine-starch to hydrogen peroxide.[13, 14]

Table 1 describes age wise distribution of the study subjects. Highest numbers of individuals were in the age group of 30-39 years. Above 70 years age range had only 2 individuals. This finding was in accordance with study conducted by Takashi Kanehira et al.[15] Female (55%) had more number of participants than males. (45%)

Three coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 112.23 ± 23 µl/ min. Two coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 220.30 ± 31 µl/ min. One coloured spot on the filter paper was obtained for the subjects with salivary flow rate of 380.11 ± 30 µl/ min. difference between the number of coloured spots and the salivary flow rate was found to be highly significant. (p≤0.05) Three coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 429.20 ± 21 µl/ min. Two coloured spots on the filter paper were obtained for the subjects with salivary flow rate of 366.45 ± 32 µl/ min. One coloured spot on the filter paper was obtained for the subjects with salivary flow rate of 200.20 ± 34 µl/ min. difference between the number of coloured spots and the salivary flow rate.was found to be non-significant. (p>0.05)

A similar study by Takashi Kanehira et al got similar results.[15] For 15 subjects with salivary flow rate of 101 ± 71 µl/ min, the filter paper showed three coloured spots. For 8 subjects with a salivary flow rate of 224 ± 67 µl/ min showed two coloured spots in the filter paper.

For 9 subjects with a salivary flow rate of 334 ± 59 µl/ min showed one coloured spot in the filter paper. For 9 subjects with a salivary flow rate of 452 ± 98 µl /min showed zero coloured spots.

## CONCLUSION

Three coloured spots appeared on the paper for patients with decreased salivary flow rate, whereas for healthy subjects with normal flow rate there was one coloured spot or none. This method of assessing saliva flow rate is inexpensive, easy to perform and well tolerated by patients. This requires no special equipment and can be used in mass health screening procedures. It takes very little time and is highly reliable.

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