

## Effects of Radiofrequencies Emitted from Mobile Phones on Teeth and Oral Tissues

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### Abstract

Number of various sources of wireless communication is had been incredibly increased in the recent decade. One of the most popular wireless communication equipment is mobile phones. However, another widespread part of wireless communications is Wi-Fis. As it is known, smart phones has many function such as speaking, Wi-Fi, bluetooth etc. Therefore, their radiofrequency radiation (RFR) level is higher than the first generation mobile phones. It means that smart phones emit higher RFR.

The results of studies performed on the effects of RFR on animal or human indicated that mobile phones are not innocent. Because of that RFRs classified as 2B (Possible carcinogen) by World Health Organization in 2011. Most of the studies usually performed on RFR and health focused on the brain tumors and other diseases. No one pay attention to the potential health effects of this electromagnetic pollutant on oral tissues and teeth, which are one of the most RFR exposed parts of heads at the beginning. Although limited number of the studies had been done on oral tissues, the results of the studies are worth considering. Therefore, the aim of this review is to summarize the results of the limited studies here.

In conclusion, the results of the studies investigated the effects of RF exposure on oral tissues and teeth indicated that uncontrolled exposures may have potential to cause some dental health problems. Finally, further studies including human studies are necessary to illuminate this topic.

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### Introduction

Wireless technologies such as mobile phones and Wireless Fidelity (Wi-Fi) communication devices have been growing tremendously over the past years. It should be noted that new generation mobile phones offers both speech and Wi-Fi services. However, rapid development of wireless technologies has steadily increased RFR levels in environment. Public and scientific awareness that was previously focused on the adverse health effects of RFR emitted from mobile phones has also shifted to the biological hazards of wireless equipment such as Wi-Fi. Although WHO

classified RFR as 2B<sup>1</sup>, health effects of this type of non-ionizing radiation are still controversial.

All the devices work by electricity produce extremely low frequency magnetic fields and all the equipment work by wireless communication produce RFR in environment. Therefore, mobile phones emit RFR and extremely low frequency magnetic fields (ELF-MF) when working. Therefore, mobile phones studies should be focused on the effects of both RFR and ELF-MF. There are a few studies performed on the effects of ELF-MFs on oral tissues or teeth<sup>2-4</sup> but they are not topic of this mini review. It should not be forgotten that the results of limited number of the studies performed on the effect of RFR exposure has been only summarized in this text.

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#### Studies performed on bone

Bone is composed of a mineral matrix reinforced by a network of collagen that governs the biomechanical functions of the skeletal system in the body. Limited number of studies

performed on the effects of RFR on bones. For instance, Sen et al. performed an experimental rat study to investigate the effects of 9.45 GHz microwave radiation on fracture healing in 1991. They formed a controlled incision in femur and exposed femur to microwave radiation. They did not observe positive healing effect on fracture healing. However, they stated that endochondral ossification was retarded by the exposed microwave<sup>5</sup>.

Durgun et al investigated effect of 2100 MHz electromagnetic radiation on the healing of mandibular fractures in rabbits. They exposed rabbits with mandibular fractures to 2100 MHz radiofrequency radiation three hours per day for twenty eight days. They observed biomechanical parameters of mandibula following radiofrequency treatment and found that energy absorption capacity, toughness and maximum strength of the mandibular bone were increased. However, the histopathological examination revealed that the fracture healing score was higher in the exposed rabbits although any radiological differences was not observed between the exposed and control rabbit. They finally concluded that 2100 MHz RF radiation positively affected fracture healing<sup>6</sup>.

### **Radiofrequency Radiation Studies Performed on Oral Tissues and Teeth**

Wireless technological equipment, which are emitting RFR has led to a dramatic increase in electromagnetic pollution and man-made sources have by far exceeded those of natural origin.

The most widely accepted mechanism of interaction between radiofrequency radiation (RF) and biological systems is based on tissue heating that occurs when tissue or total body temperature increases for more than 1 °C overloading cell thermoregulatory capacity. However the effects, which is happening at non-thermal level have still to be investigated and very little is known about their molecular mechanism<sup>7</sup>.

Therefore public concerns have been focused on health effects of mobile phones after the studies, which are stated health risks of uncontrolled use of mobile phones and other wireless equipment. Although many of studies pointed out brain tumor effects of mobile phones very limited studies are still available on the effect of RFR on oral tissues/teeth. For a long

time, no one usually pay attention to the effects of RFR emitted from mobile phones on teeth or oral tissues although cheeks and teeth exposes radiation since mobile phones are attached to the ear during talking. Therefore more performance is necessary to understand the effects of RFR on oral tissues and teeth. Kaya et al investigated the effects of long term exposure of 900 MHz RFR emitted from mobile phone on periodontal tissues and teeth of rats. They used a 900 MHz radiofrequency generator to standardize the RF exposure and simulate mobile phone exposure. Rats were exposed for 2 h/day for ten months. The result of the study indicated that RF has potential to affect periodontal ligaments and alveolar bone. However, they stated that RF exposure may have caused abnormal histological changes such vasodilatation and focal bleeding in periodontal ligament, alveolar bone, gingiva and pulpa<sup>8</sup>.

Adiguzel et al also investigated the long term exposure effect of 900 MHz radiofrequency radiation on trace element content of rat teeth. They analyzed some of trace element content such as Ca, Mg, Zn, and P in teeth. Results of the study showed that 900 MHz RF altered concentration of the measured trace elements. However, only Mg and Zn content in teeth of exposed rats were found statistically significant<sup>9</sup>. On the other hand, Dasdag et al investigated effect of long term 900 MHz radiofrequency radiation on enamel microhardness of rat's teeth. They also found that 900 MHz RF radiation do not alter the enamel microhardness of rats' teeth<sup>10</sup>.

However, Ciftci et al investigated effects of prenatal and postnatal exposure to 2.45 GHz radiofrequency radiation (Wi-Fi) on teeth and surrounding tissue development as well as trace element concentration in growing rats. They exposed rats to 2.45 GHz RF for 2 h/day during the pregnancy (21 days) and lactation (21 days). They found no difference in terms of development and apoptotic activity in the exposed rats. However, trace elements such as iron and strontium concentrations were increased in the RF exposure group, whereas boron, copper, and zinc concentrations were decreased. They also did not find difference in calcium, cadmium, potassium, magnesium, sodium, or phosphorus values in the exposed rats. Additionally, they stated that short-term exposure to Wi-Fi may cause an imbalance in the oxidative

stress condition in the teeth of growing rats<sup>11</sup>.

## Discussion

As it is discussed above there are very limited number of the studies performed on the relation between RFR exposure and oral tissues including teeth. The studies on the effects of RFR emitted from wireless equipment can be grouped under two headings such as mobile phones and Wi-Fi.

The result of the RFR exposure studies can be summarized as;

- 900 MHz RF exposure has potential to affect periodontal ligaments and alveolar bone. RF exposure may have causes some abnormal histological changes such as vasodilatation and focal bleeding in periodontal ligament, alveolar bone, gingiva and pulpa.
- 900 MHz RF exposure has also potential to alter the concentration of some trace elements.
- 900 MHz RF radiation has no potential to alter the enamel microhardness of rats' teeth
- Short term 2.4 GHz RF exposure has potential to alter the concentration of some trace elements. However, Wi-Fi exposure may cause an imbalance in the oxidative stress condition in the teeth of growing rats.

The result of Mg and Zn in 900 MHz RFR studies was not supported by the 2.4 GHz RF exposure study. The contradiction between two frequencies may have originated from the difference of frequency, exposure duration, exposure setup and animals.

If we generalize the result of the studies performed on RFRs, we can conclude that RFR have potential to alter histological structure of oral tissues and teeth. Therefore, dentists should not forget to ask their patient's wireless devise usage habits when they face the complaints summarized in this review.

## Conclusions

In conclusion, the results of the studies investigated the effects of RFRs on oral tissues and teeth indicated that such exposures have potential to cause some complaints. However, further studies including human studies are

necessary to illuminate this topic.

## Declaration of Interest

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