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RESEARCH ARTICLE

EFFECT OF WI-FI RADIATIONS ON AMALGAM RESTORATIONS IN CLASS V CAVITIES USING ICP-OES-AN IN VITRO STUDY

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Abstract

Context: This study has been conducted to study the effect of wifi radiations on amalgam restorations.

Aims: To evaluate the release of mercury from class V cavities in presence of Wi-Fi radiations.

Methods and Material: 20 extracted human molars were taken and standard cavity of class V was prepared. The 20 sample teeth were then put in two different groups .10 teeth were put into a control group which was kept in an environment devoid of Wi-fi radiation. The remaining 10 teeth were kept in an environment with exposure of Wi-Fi radiation for time period of 25 mins at 2.4 GHz radiation. The mercury concentration found in the artificial saliva in both the groups was measured by using an Inductively Coupled Plasma Optical Emission Spectrometry ICPOES.

Statistical analysis used: Statistic evaluation was done using independent t test.

Results: The mercury release found in artificial saliva which was in experimental group of WiFi exposure had mean concentration of 0.046mg/L, while for control group the mean concentration recorded was only 0.022 mg/L. statistically significant difference was recorded ($P=0.009$).

Conclusions: With presence of wi-fi radiations all around us the effect of this artificial radiation on amalgam needs to be studied and analysed carefully considering the number of amalgam fillings in patients mouth.

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Introduction: -

Human beings discovered various metals out of which one is mercury which is found in various forms and is liquid under standard conditions (temperature and pressure).¹ It has many applications such as in thermometers, barometers, batteries, fluorescent lamps, mercury switches, and some insecticides.²

It can be mixed with gold and silver and almost all metals creating alloys, called amalgam. Dental amalgam is one of the oldest material used in dentistry with various application.³ In dentistry it is most widely used restorative material in posterior teeth because of its high mechanical strength, durability, ease of manipulation, and low cost^{4,5}.

Dental amalgam is comprised of: 50 % Mercury, Silver, Tin, Copper, palladium, indium and zinc.^{6,7}

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It can be used as a material for restoration with low cost and yet there is no cost-effective replacement for this material⁸.

In spite of all such clinical uses it is considered to have many deleterious effects in vicinity of living organisms and biological environments, known as mercury toxicity.⁹ Mercury is a toxic element which can damage various organs such as central nervous system, renal, respiratory and hematologic systems^{10,11}. Some of the horrible threats of the mercury is its concentration in the brain tissues, and its hazardous effects on the nervous system, and its trace has been found in many diseases such as Alzheimer's¹² and Parkinson's disease, and more recently heart failure.^{13,14}

Previously amalgam seemed to be safe,¹⁵ but in recent years it has been observed that there is release of mercury from amalgam in form of fine particles and can be inhaled or swallowed by patients with restoration. Consequently, its adverse health effects have become a serious and ongoing debate in recent years^{16,17}

The amount of mercury which releases from amalgam restorations depends on several factors such as:^{8,18}

1. Size of the filling.
2. Composition of amalgam.
3. Factors that cause load over restoration like tooth brushing, chewing habits, and bruxism.

Also, it has been observed that electromagnetic radiation and various other frequency effect the amalgam restoration and leads to release of particles from them.¹⁹

Recently there has been increasing demands of Wi-Fi i.e. wireless computer networking technology and its use in houses and public places such as schools and hospitals. It allows electronic devices such as personal computers, video-game consoles, smart phones, digital cameras and tablet computers to network using Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards. These standards mainly use the 2.5 gigahertz (12 cm) UHF and 5 gigahertz (6 cm) SHF ISM radio bands.²⁰ There is increase in Wi-fi devices than traditional wired computer network due to its low cost and rapid development.

Signals arising from these devices are the part of continuous spectrum of waves are non-ionizing radiations, and for a while only their thermal effects were taken into consideration to be evaluated for their adverse effects. Some researchers have noticed that electromagnetic waves can affect the mercury release rate from the amalgam.^{21,22}

This has been a question of great concern among public about the potential adverse effects of exposure to electromagnetic fields (EMFs) emitted from these devices.²³

The adverse health impacts associated to exposure to some common sources of electromagnetic fields including laptop computers, mobile phones, MRI and mobile phone jammers have been evaluated in laboratory²⁴⁻²⁶.

To the best of our knowledge, this study will determine the release of mercury and help public to take precautions and also bring a ban on such materials with harmful effect.

Subjects and Methods:-

Teeth samples:

20 non-carious molar teeth extracted for orthodontic treatment were included in this study. The teeth were cleaned and kept in isotonic saline solution for 3 months. The teeth were arbitrarily separated into 2 groups, exposure group and control group. Both groups consisted of 10 teeth each.

Ethical clearance was acquired from our institute to carry out the following study.

Inclusion criteria:

Freshly extracted human maxillary and mandibular molars.

Exclusion criteria:

Teeth should be free of any defects, caries, fractures and previous restorations.

20 freshly extracted human molar teeth with no defects (caries, restoration, fractured) will be collected and will be cleaned of calculus, soft tissue and other debris using ultrasonic scaler followed by its storage in a physiological solution at 37 degree centigrade until used. The teeth will then be randomly assigned and divided into two groups with ten teeth per group. Standardized class V cavities (3mm in length, 2mm in width and 1.5mm in depth) will be prepared on the buccal surfaces of the teeth, 1mm above the CEJ using a No. 1 or No. 2 round bur (Mani).

The cavity prepared will be standardized using a William's graduated periodontal probe. The cavities on buccal surface will be restored by applying zinc phosphate base and filled with silver amalgam.(Figure 1) The restored teeth will be kept in saline solution 37 degree for 14 days.²⁷

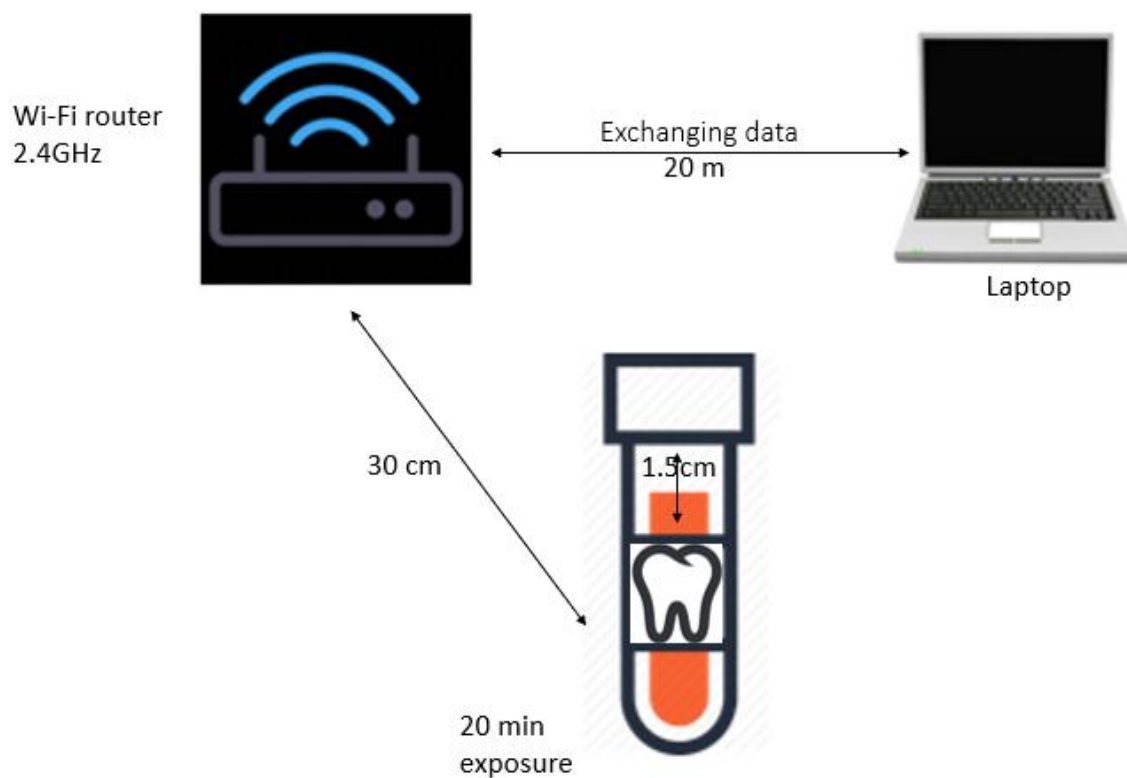
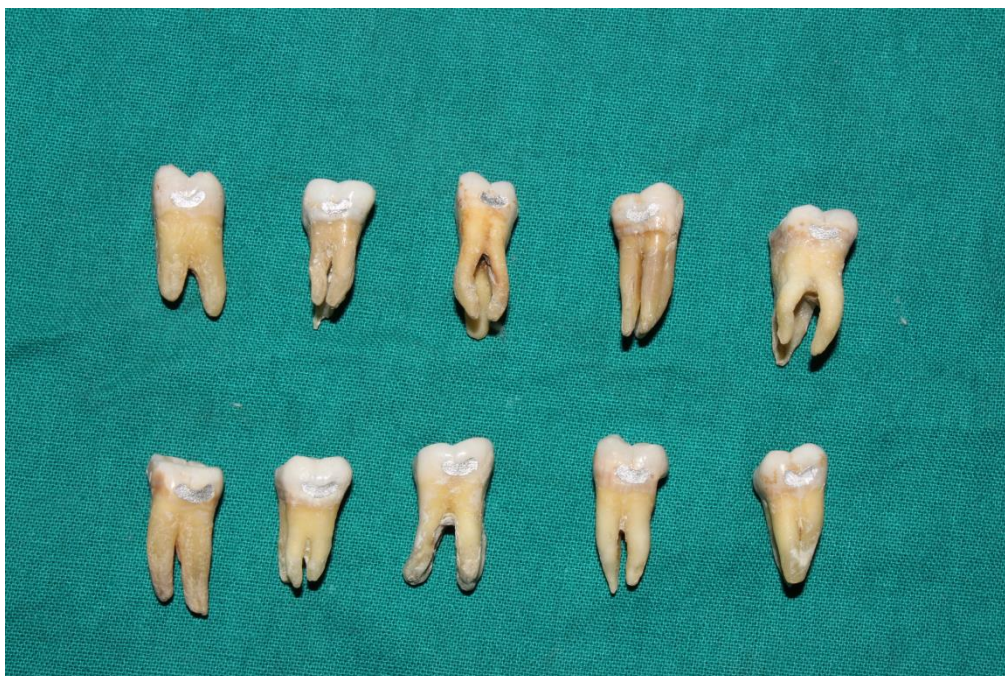
Subsequently the tooth samples groups were transferred in plastic tubes that were occupied with artificial saliva.

The exposure group will be exposed to Wi-Fi device for 25 mins at 2.4 GHz. A 30 cm distance was maintained between the the teeth samples and Wi Fi router, the router was swapping internet data with a laptop that was placed 30 m away from the router.(Figure 2)

The control group will be placed outside experiment room. The level of mercury present in artificial saliva was measured after exposure by ICP OES.(Figure 3) The concentration of mercury in the artificial saliva of the experimental group and control group were observed and compared.

The level of mercury was evaluated in the artificial saliva after exposure by ICPOES(THERMO Scientific) (Fig. 1)



**Statistical analysis:**

The data was analyzed using SPSS version 16.0 (SPSS Inc., Chicago, IL) (<http://www-01.ibm.com/software/analytics/spss>). To compare the level of mercury release in the experimental group and control groups independent t test was used to find any statistically important differences. (P value <0.05)

Results:-

The mercury release found in artificial saliva which was in experimental group of WiFi exposure had mean concentration of 0.046mg/L, while for control group the mean concentration recorded was only 0.022 mg/L. statistically significant difference was recorded ($P=0.009$).

So, the mean concentration of mercury level in the Wi-Fi exposed group i.e experimental group was about twofold of the control group. The observed difference in the concentration of mercury in the artificial saliva of the exposure and control group was statistically significant ($P=0.009$)

Discussion:-

Wi Fi is the modern technology, which is growing speedily as the wireless communication systems. Wi Fi unit includes Wi Fi antenna which is connected to the internet and sequences of laptops, computers and wireless devices like cell phones and cameras. The mentioned devices can thus communicate wirelessly with the internet.²⁸

It has been claimed by the telecommunication industries linked groups and individuals that Wi Fi cannot per chance have any health impact as such.(Foster and Moulder, 2013; Berezow and Bloom, 2017). Nevertheless, the Wi-Fi exposures are becoming more prevalent and exposing many of us to its radiation without our consent, the concerns about Wi Fi exposure on health are increasing.

Wi-Fi studies have shown that Wi-Fi can cause oxidative stress, neuropsychiatric effects including EEG changes, sperm/testicular damage, cellular DNA damage, apoptosis, endocrine changes, and calcium overload on its repeated exposure. Exposures to other microwave frequency EMFs also cause the above mentioned effects, these effects have been documented in 10 to 16 reviews. Thus, each of these seven EMF effects are established effects of Wi-Fi and of other microwave frequency EMF.²⁸

In our present study it was proved that because of radiations of Wi Fi there was considerable amount of increase in mercury release from amalgam restorations.

In spite of concerns regarding mercury (Hg) toxicity, dental amalgam is still worldwide a commonly used dental restorative material. The World Health Organization (WHO) has recommended phasing out dental amalgam and change to alternative materials (WHO, 2007). However, these alternatives may be too expensive for middle- and low income nations and amalgam is therefore still a preferred dental restorative material in large parts of the world. Environmental Research 2018

Norway and Sweden have banned the use of amalgam, reportedly because of environmental reasons (Ministry of the Environment, 2007; Swedish Chemicals Agency, 2008–2012). In Denmark, Finland, Estonia, and Italy, the use of dental amalgam is less than 5% of all tooth restorations (BIO Intelligence Service, 2012). In Switzerland and Japan, the use of the filling material is about to be banned (BIO Intelligence Service, 2012). The health authorities of France have recommended Hg free alternatives for amalgams for pregnant women. In Finland, Austria, Germany, and Canada, the use of dental amalgam has purposely been reduced for children, pregnant women, and subjects with kidney problems (HEAL, 2007). Other industrial countries are also in the process to phase out the use of dental amalgam (UNEP, 2016).

The various published reports on the amplified release of mercury from amalgam fillings in cavities post exposure to diverse sources of electromagnetic fields like MRI, mobile phones has been reviewed by Mortazavi.²⁹

Mortazavi and his colleagues to overcome confines of their previous study have lately considered the effects of stronger magnetic fields 1.5 T in their current study vs. 0.25 T in their previous report. The previous findings were confirmed in this study and which provided additional support for amplified release of mercury from dental amalgam fillings after MR imaging.³⁰

So the aim of our study was to evaluate the effect that Wi Fi radiations could have on amalgam restoration fillings. This study employed ICP OES method for measuring mercury released from dental amalgam. The cavities were not polished after restoration in order to improvise the result of the probable mercury release, as according to Ferracane et al. unpolished surface of amalgam restoration releases larger amounts of mercury than polished surfaces.³¹

Though the adverse health impacts of the exposure to Wi-Fi emitted radiofrequency radiation routers has some challenging phenomena such as human reproductive capabilities is well documented by some researchers around the world^{32,33}

To best of our knowledge, there are very few reports on the role of Wi-Fi radiation on the release of mercury from amalgam restorations. The released mercury in saliva from dental amalgam into has been estimated in earlier studies both in vitro and in vivo conditions^{34,35,36,37}.

This study is significant as it highlights the ill effects of both mercury and Wi Fi radiations on human beings and what outcome might we get if we keep on using it.

Conclusion:-

There is increase in public apprehension about the conceivable adversative health impact of using Wi-Fi technology is increasing because of the extensive use of wireless communication systems. As far as dentistry is concerned this effect of Wi-Fi should be given more consideration and more studies should be conducted. Given all the hazardous effects of mercury, all the precautions should be taken to avoid any type of contact with mercury.

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