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AWARENESS OF RADIATION INDUCED ORAL DAMAGE AMONG DENTAL STUDENTS

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ABSTRACT

The aim of this study is to assess the knowledge and attitudes regarding radiation induced oral damage amongst the dental students. The purpose of this study is to create awareness and determine the understanding of radiation induced oral damage among dental students. This study was conducted based on a questionnaire which consisted of 10 questions through a web-linked application called Survey Monkey. A convenient sample size of 100 consecutive dental students who are currently practicing in Chennai participated in the study. As an overall result, most of the participants are aware of radiation induced oral damage. As a conclusion, the awareness of radiation induced oral damage and development among dental students in Chennai is adequate but certain knowledge has to be brushed up among them for a higher level. Furthermore, they need to be trained on these grounds to help them treat their patients with more consent and awareness.

KEYWORDS: *Radiation, oral, damage, dental, student.*

I. INTRODUCTION

Ionizing radiation is defined as a radiation which has sufficient energy to ionize biological molecules.(Andrews and Griffiths, 2001) Exposure to such radiation for human tissue is harmful. X-rays which are widely used in diagnostic radiology in dental fields are also a type of ionizing radiation .Due to production of low energy X ray photons, the creation of reactive free radicals which are capable of producing substances that are poisonous to the cell, production of unstable atoms and free electrons and injury to the cell that may itself manifest as loss of function, are the consequences of ionization to the human cells.(Curi et al., 2007) The biological effects to the human body can be divided into deterministic effects and also stochastic effects.(Delanian and Lefaix, 2004)

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Deterministic effects are proportional to the dose whereas stochastic effects are caused by sublethal radiation induced damage to the DNA. It is a known fact that dental professionals are frequent with performing X-ray investigations .(Denys et al., 1998) Almost all the dental treatments like RCT's, extractions, implants and much more require radiographs for proper treatment planning. Further, the literature also reveals that high paediatric also acquires radiological investigations.(Dijkstra et al., 2004) Furthermore, the most often radiological procedure performed is an intra oral periapical radiograph which is done to evaluate the tooth and its periapical area. It is well documented by several researchers that the radiation exposure during dental radiograph such as IOPA as well as OPG is quite low.So the radiographs should be prescribed only for a patient when it is required for diagnosis and to treat the pathology.(United Nations. Scientific Committee on the Effects of Atomic Radiation, 2010) The radiation exposure amount from dental radiographs depends on variable factors like speed of film, exposure factors, technique used to take radiographs, collimators and use of a protective barrier. However, unwanted and repeated examinations must be avoided.(Prasad et al., 2016) It is widely observed that there is a lack in the quality assurance programmes as far as the radiographs are concerned . Hence, these radiation safety measures are considered important for the dental professionals. The exposure to radiation in the maxillofacial region may contribute to the tumors of salivary glands, cancer of thyroid gland and meningioma to name a few.(Arnout and Jafar, 2014) Henceforth, justification and optimization of dental radiology is considered an important aspect for dental professionals so as to reduce the unwanted radiation exposure and to provide or reduce oral damages .(Ramanathan and Ryan, 2015)

The biologically damaging effects of ionizing radiation are classified into three main categories such as somatic deterministic effects which are defined as those damaging effects resulting from a specific high radiation dose. The severity of effect is proportional to the dose. Examples include oral changes seen after radiation therapy, skin reddening and cataract formation.Somatic stochastic effects are the effects in which the probability of the occurrence of a change, rather than its severity, is dose dependent. Henceforth, these can manifest by exposure to any radiation dosage and it is of interest to note that experimentally there is no such safe dose which cannot manifest the stochastic effects . Hence there is a dire need to check the unwanted usage of ionizing radiation.(Bushong, 1994) Examples of such effects include leukemia, certain tumors and radiation induced cancer. Moreover, genetic stochastic effects can lead to mutations resulting from any sudden changes to a gene or chromosomes. These changes can be triggered by external factors, such as radiation or may even manifest spontaneously.

In addition, the mechanism of radiation injury can be divided into direct effects which are the effects that happen when the X-ray photon or the secondary electrons directly ionize the biologic tissues and indirect effects. Water acts as a medium and the X-ray photons are first absorbed by the water in the body of the individual leading to ionized water molecules. This further leads to formation of free radicals and thus interacts and produces changes in biologic tissues.

II. RADIATION EFFECTS ON ORAL TISSUES

Oral Mucous Membrane

Oral mucous membrane consists of a basal cell layer containing vegetative and differentiating intermitotic cells which are radiosensitive. Due to radiation, some of these cells die during or at the end of the second week of therapy.(Salaam et al., 2016)Thus the mucous membrane will become red and inflamed. This clinical condition is known as Mucositis. At later intervals which can be months to years, it tends to become atrophic and also becomes thin and avascular relatively owing to progressive obliteration of vascular lumens. These atrophic changes create problems in patients with denture as there may be oral ulcerations of the compromised tissue due to trauma from the hard dentures.(Asha et al., 2015; Salaam et al., 2016)

Taste Buds

Taste buds are very sensitive to radiation. Therapeutic doses during the second to third week of radiotherapy can cause extensive degeneration of the normal histologic architecture of taste buds which may lead to loss of acuity of taste.(Srivastava et al., 2017)

Salivary Glands

The parenchymal component of the salivary glands is radiosensitive and the parotid gland is usually more radiosensitive as compared to the submandibular gland or sublingual glands.(Srivastava et al., 2017)The following changes that take place in the first few weeks after the initiation of radiotherapy and also what happens after irradiation are, there will be progressive loss of salivary secretion, the extent of reduced flow is dose dependent and reaches essentially 0 at 60 Gy and mouth becomes dry and tender too. Furthermore, swallowing will be difficult and painful as the residual saliva loses its normal lubricating properties and it's buffering capacity falls as much as 44%. The small volume of viscous saliva that is secreted usually has a PH value 1 unit below normal, which is enough to initiate decalcification of normal enamel and also if some portions of the major salivary glands have been spared, dryness of the mouth usually subsides in 6 to 12 months due to compensatory hypertrophy of residual salivary gland tissue. Henceforth, reduced salivary flow that persists beyond a year is unlikely to show significant recovery and the glands demonstrate progressive fibrosis, adiposis, loss of fine vasculature and concomitant parenchymal degeneration which accounts for xerostomia.

Trismus and fibrosis

Trismus may begin shortly after radiation begins. Patients suffering from tumors of the palate, nasopharynx, and maxillary sinus are most likely to develop the trismus. If unmanaged, trismus makes eating and swallowing difficult and various dental clinical procedures almost impossible. Trismus can be a significant side effect of radiotherapy especially if the lateral pterygoid muscles are in the field. In patients whom the pterygoid muscles were irradiated and not the temporomandibular joint 31% experienced trismus. Limited mouth opening can interfere with

proper oral hygiene and dental treatment. Tongue blades can be used to gradually increase the mandibular opening.(Little, 2003) Dynamic bite opening appliances have also been used. Primary treatment is essentially to exercise the involved muscles.For patients who experience reduced mouth opening the intensity and frequency of the exercise should increase. Its development is thought to progress in three phases such as an initial nonspecific inflammatory phase, a fibrotic cellular phase, and a matrix densification and remodeling.(Konings et al., 2005; Little, 2003) It is generally viewed to be the result of fibrosis leading to a loss of flexibility and extension. Usually temporomandibular joint hypomobility is regarded as a late effect of high radiation dose. An oral opening lower than 20 mm can be considered as trismus.

Teeth

Irradiation with therapeutic doses can retard the growth of the teeth if the irradiation occurs during their development stage. Irradiation during or before the calcification stage of the teeth can even destroy the tooth in its bud form. Furthermore ,after calcification may inhibit cellular differentiation, causing malformations and arresting general growth.(Konings et al., 2005) Children receiving radiation therapy of the jaws may show defects in the permanent dentition which includes retarded root development, dwarfed teeth and failure to form one or more teeth. Teeth irradiated during development may complete calcification and erupt prematurely. Moreover ,irradiation of teeth may have an effect on the root formation while it is of interest to note that the eruptive mechanism of teeth is relatively radiation-resistant. This means that the teeth in which there is altered root formation due to radiotherapy will still continue to erupt.(Köstler et al., 2001)

Radiation Caries

It is a rampant form of dental decay. It occurs in those individuals who receive a course of radiotherapy that includes exposure of the salivary glands and results from changes in the salivary glands and saliva, including reduced flow, decreased pH level, reduced buffering capacity, increased viscosity, and also presence of debris or plaque.(Köstler et al., 2001; Rabhat et al., 2011)

Craniofacial Disturbances

The craniofacial disturbances are those that will occur when radiation therapy is performed in children. This way, irradiation may induce some disturbances in the craniofacial region. It is performed in earlier stages, when teeth are still being formed. Abnormally microdontia, short or blunted roots, small crowns, malocclusion, incomplete calcification, taurodontism, premature closure of apices and delayed or arrested development of teeth are such examples. The occurrence of these changes in the primary teeth can cause significant malocclusion and may affect facial development. Moreover, children undergoing radiation therapy may experience abnormalities in the growth and maturation of craniofacial skeletal structures.(Mitchell and Logan, 1998) Hence, craniofacial and dental abnormalities can cause severe cosmetic or functional sequelae.

Bone

Radiation therapy with therapeutic doses may lead to damaging effects on the bone of the maxillofacial region owing to damage to the vasculature of the periosteum and cortical bone. It may also be due to the destruction

of osteoblasts as well as osteoclasts. Resultantly in a nutshell the marrow tissue becomes hypovascular, hypoxic and hypocellular. Endosteum becomes atrophic, showing a lack of osteoblastic and osteoclastic activity. Some lacunae of the compact bone are empty which is an indication of necrosis. Degrees of mineralization may be reduced, leading to brittleness.(Mitchell and Logan, 1998; Rout, 1988) Therefore , bone death occurs because of these changes, the condition is termed osteoradionecrosis. Osteoradionecrosis refers to an inflammatory condition of bone known as osteomyelitis that occurs after the bone has been exposed to therapeutic doses of radiation usually given for a malignancy of the head and neck region. It is characterized by the presence of exposed bone for a period of at least three months occurring at any time after the delivery of the radiation therapy. This infection may result in non-non-healing wound in the bone which is difficult to treat. It is more common in the mandible than in maxilla because of the richer vascular supply to the maxilla and the mandible is frequently irradiated.(Rout, 1988)

III. MATERIALS AND METHODS

A convenient sample size of 100 consecutive dental students who are currently pursuing in Saveetha Dental College, Chennai participated in the study. A cross-sectional observational online based study was conducted. Questionnaire was constructed on the Survey Monkey website with dichotomous questions. The questionnaire consists of 10 questions as shown in Table 1. A link containing these questionnaires was shared with all the participants and required them to answer the questions. All the responses were analysed and recorded.

QUESTIONS
1. Are you aware that radiation induces oral damage in patients?
2. Does high radiation lead to oral cancer?
3. What is the approximate effective dental radiation dose for an individual?
4. Osteoradionecrosis often occurs in?
5. Which salivary gland is the most radiosensitive?

6. Are you aware that radiation affects the calcification process of the developing teeth?

7. Do you know whether radiation affects the flow, viscosity and pH level in saliva

8. The most common acute side effect experienced by the patient undergoing radiotherapy?

9. Which among the following do you think will be the most appropriate way of awareness of radiation induced oral damage?

Table 1 shows dichotomous questions asked in questionnaires.

IV. RESULTS AND DISCUSSION

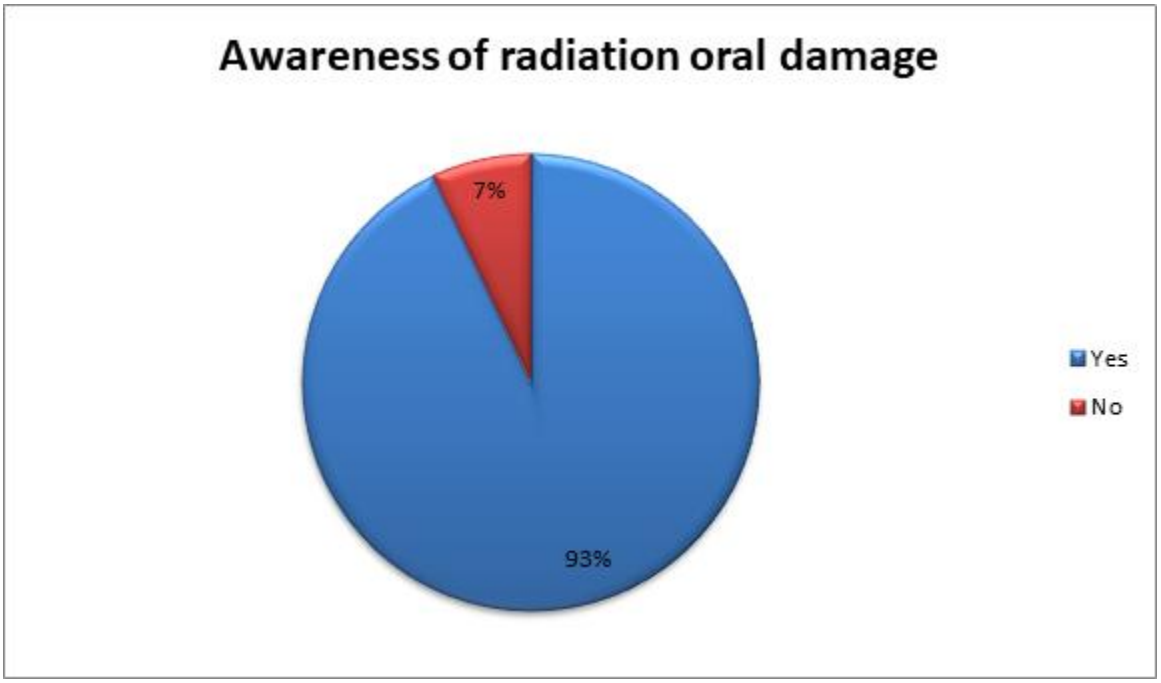

FIGURE 1: shows the percentage of participants who are aware that radiation induces oral damage in patients.

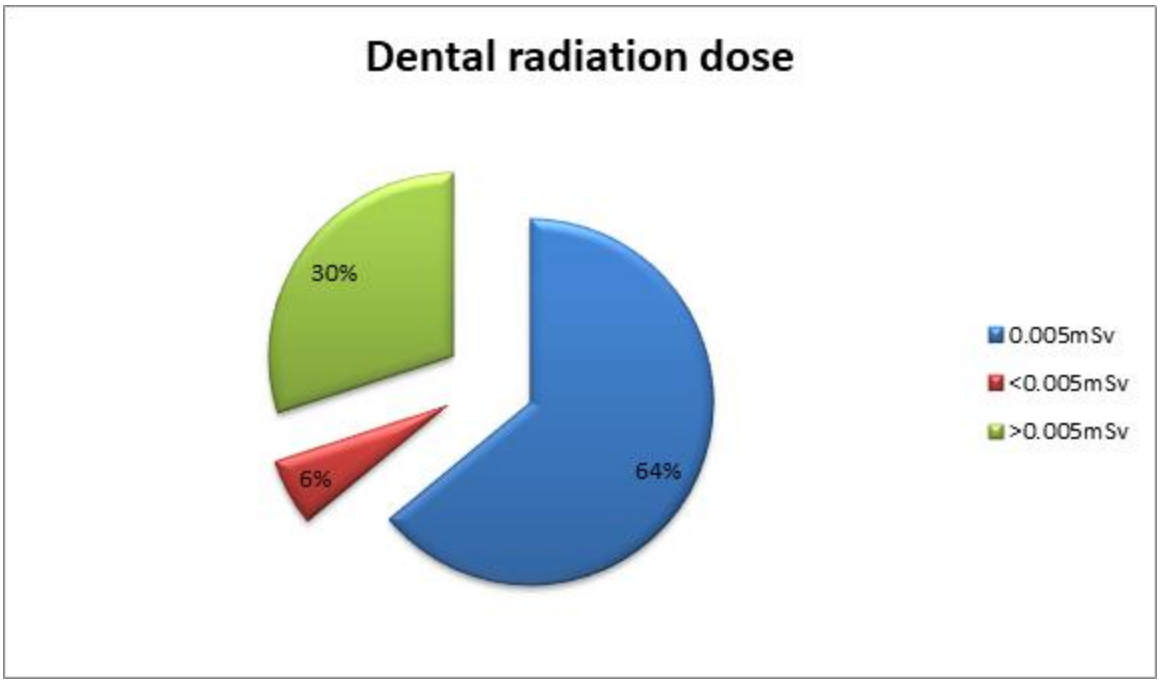

FIGURE 2: shows the percentage of participants who have the knowledge about the approximate effective dental radiation dose for an individual.

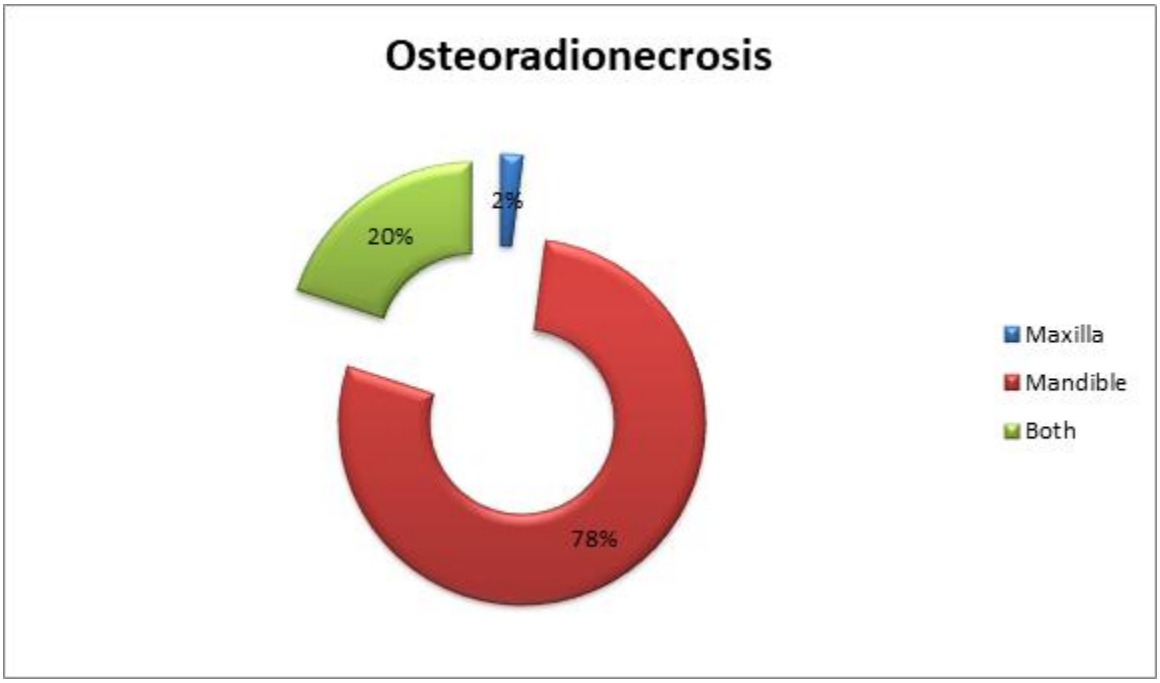

FIGURE 3: shows the percentage of participants who responded about the most common site for osteoradionecrosis to occur.

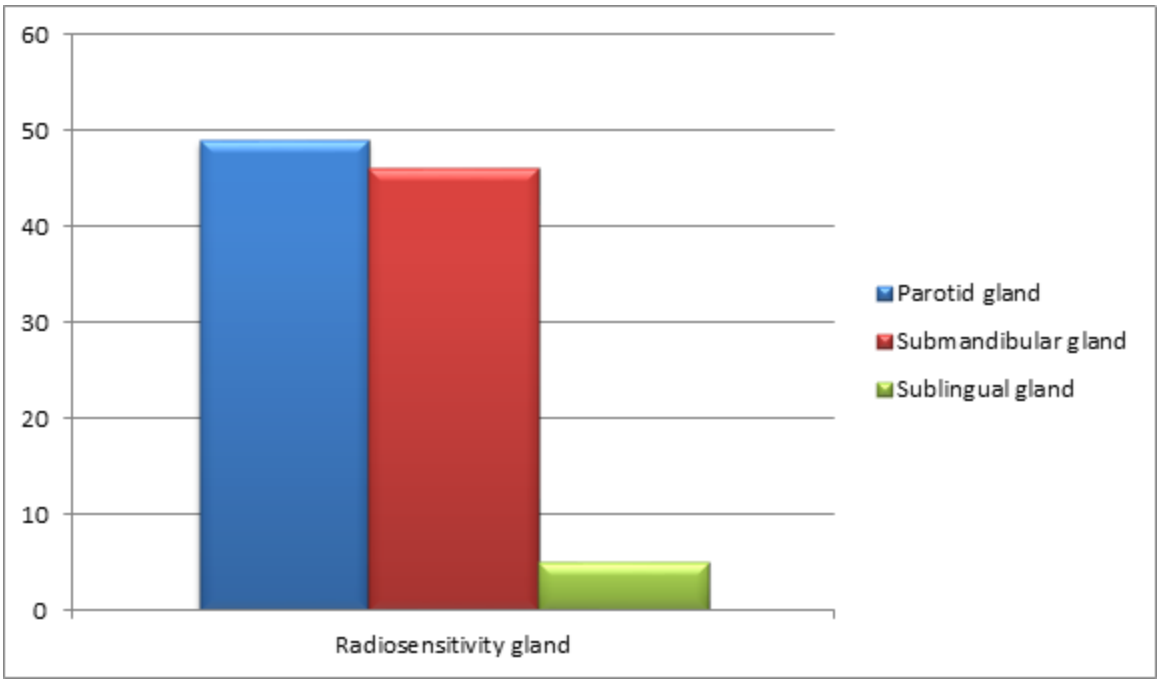

FIGURE 4: shows the percentage of participants who responded regarding their insinuation on which salivary gland is the most radiosensitive.

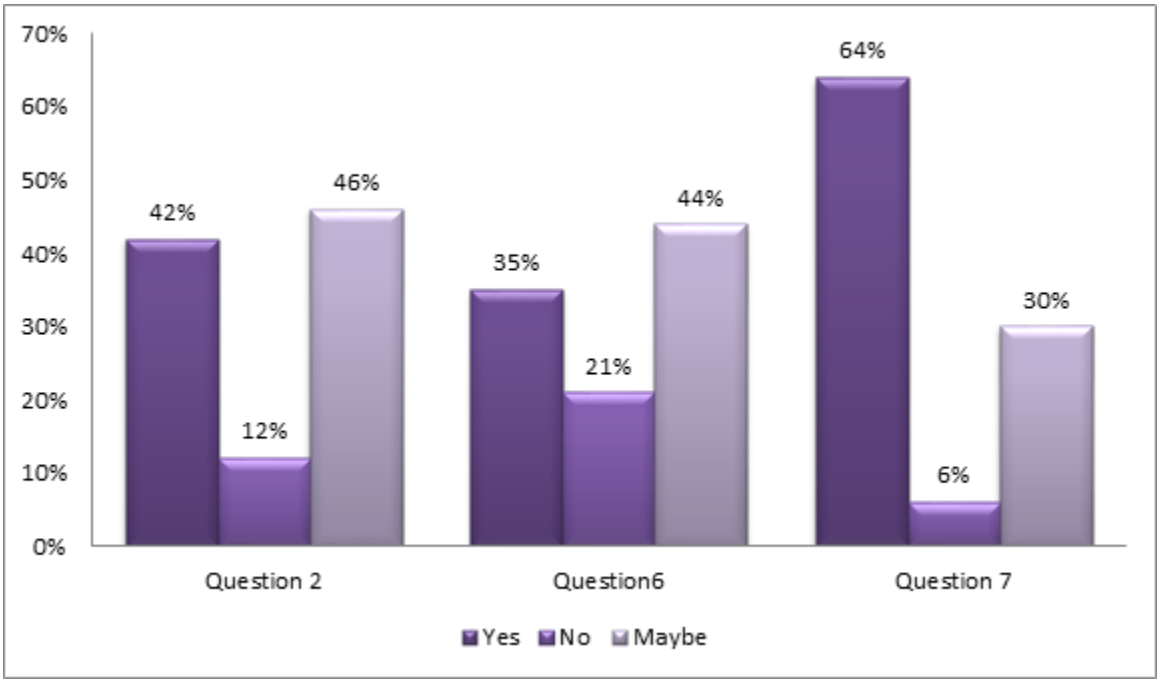

FIGURE 5: shows the percentage of participants who are aware whether radiation leads to oral cancer (Question 2) and also if radiation affects the calcification process of the developing teeth(Question 6.) Participants also responded whether radiation affects the flow, viscosity and pH level in saliva (Question 7).

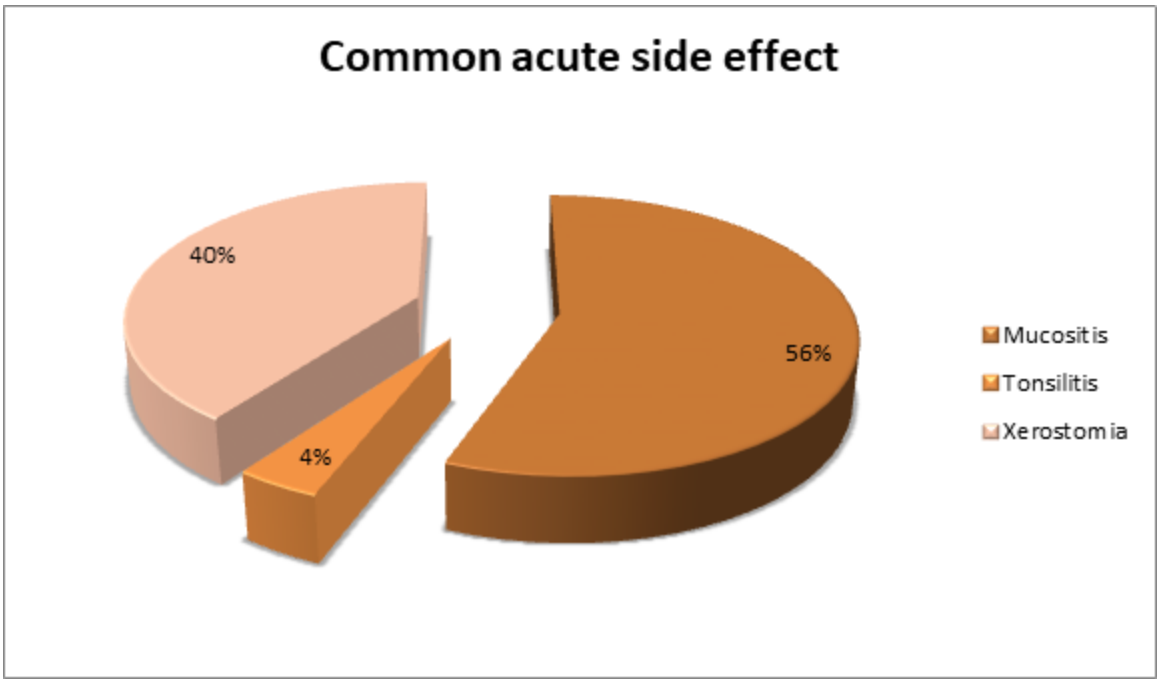

FIGURE 6: shows the percentage of respondents about the knowledge of most common acute side effects experienced by the patient undergoing radiotherapy.

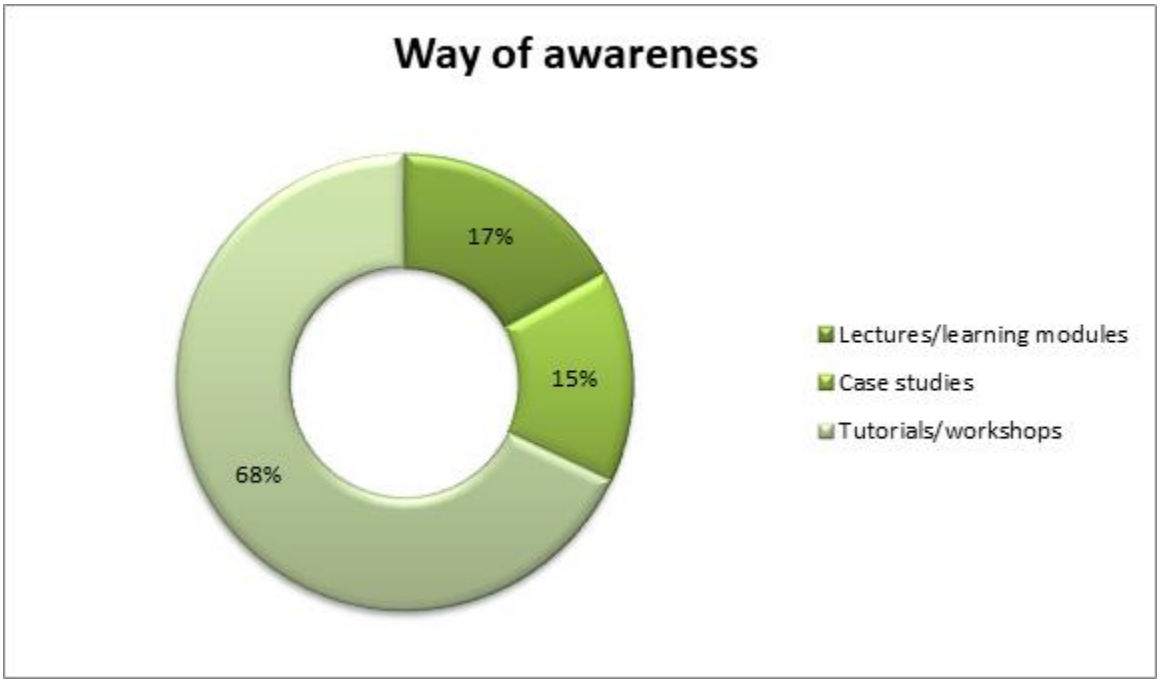

FIGURE 7: shows the percentage of participants who responded about their opinion and choice for the most appropriate way of awareness of radiation induced oral damage.

According to figure 1, 95% of the participants have claimed that they are aware that radiation induces oral damage in patients. Remaining 5% of them are not aware that radiation induces oral damage in patients. Surprisingly, 42% of the participants answered 'yes', high radiation leads to oral cancer. Remaining 12% and 46% of them chose the option 'No' and 'Maybe' respectively, as shown in figure 5.

When asked about the approximate effective dental radiation dose for an individual 64% of them were aware about the appropriate dose. Remaining 6% and 38% of them seem to be unaware of the importance as they choose the option '<0.005mSv and >0.005mSv' for this question. According to figure 3, 78% of the participants chose mandible as osteoradionecrosis often occurs in this site. Next, 2% and 520% of them chose maxilla and both maxilla and mandible, respectively. Majority, 78% answered correctly by choosing mandible as the most common site for osteoradionecrosis to occur. Moreover, only 35% of the participants were aware that radiation affects the calcification process of the developing teeth and 21% of them were unaware about it. The remaining 44% chose the option 'Maybe' as they were skeptical about this question.

The next question was asked whether the participants have the knowledge whether radiation affects the flow, viscosity and pH level in saliva and 64% answered correctly by choosing 'Yes'. About 6% answered 'No' and the remaining chose the option 'Maybe'. Figure 4 showed answers by the participants for the question asked about the most radiosensitive salivary gland. About 49% of them chose parotid gland and another 46% chose submandibular gland. Remaining 5% of them chose sublingual glands.

Following question was asked about the most common acute side effects experienced by the patient and 56% of them answered correctly by choosing 'mucositis'. About 4% of them chose the option 'tonsillitis', as shown in figure 6. Remaining 40% chose the option 'xerostomia'which can be seen in figure 6.

Finally, when asked about the appropriate way of awareness that should be implicated towards the students, about 17% of them answered 'lectures and learning modules'. Remaining 15% and 68% only chose case studies and tutorials or workshops, respectively as seen in figure 7.

Damage to these tissues by tumor or therapy can result in significant structural, cosmetic and functional deficits that negatively impact on quality of life. According to previous study conducted by Curi MM, et al, of the long term survivors treated with radiation therapy, 77% to 100% have mild-to-severe radiation damage of soft tissues and bones. The major clinical problem for patients developing oral mucositis is pain. Its adverse consequences include a decreased ability to eat, speak and sleep.(Curi et al., 2007; Rout, 1988) The loss of the integrity of the oral mucosa also predisposes patients to systemic infections with bacteria, yeast and viruses which was proposed Konings AW, et al, evaluated the oral sequelae of radiotherapy in patients treated for head and neck tumors and showed that the main effect of radiotherapy in the head and neck region was a reduction of the salivary flow rate.(Konings et al., 2005)

According to Andrews N, et al, he evaluated 39 patients with the side effect xerostomia. All patients received radiotherapy that included the parotid glands in the radiation field >50 Gy. The toleration rate was only 47%. The most common adverse effect was sweating with an incidence of 64%.(Andrews and Griffiths, 2001) The decision to extract teeth before or after radiotherapy has traditionally been based on clinical experience and empirically designed protocols. The literature data regarding dental evaluation and extraction are confusing and inconclusive, showing conflicting results when comparing extractions before and after radiation therapy, and the main cause of this decision is the possibility to develop Osteoradionecrosis.(Kada, 2017) An important point when considering dental extractions before radiotherapy is the time interval between dental extractions and the beginning of radiation therapy. This time must be sufficient for initial healing and to allow that tissues support the radiation delivered. The prevalence of post-radiotherapy mandibular hypomobility has been reported to vary between 5% and 38%. The variable incidence of mandibular hypomobility within this patient cohort appears to depend on a number of factors, which include the location of the tumor, the nature and extent of surgery, the field of tissue irradiated, the use of combined surgery and adjunctive radiotherapy, and the level of movements performed by the patient in the period immediately following treatment. The management of irradiated patients is a challenge to the dentist.(O'Sullivan et al., 2010) Most clinicians do not know when and how to intervene in these patients. There is no consensus in the literature about a standard oral attendance protocol to prevent and treat the patients in these cases. Overall procedures must be accomplished 20 to 30 days before the first session of radiotherapy, for tissue repair and healing. After the radiotherapy treatment, the dentist can perform non-invasive procedures, such as small restorations; placement of new prostheses should wait 3 months; and at least 6 months should have been elapsed to perform surgeries. The invasive procedures should be accomplished under prophylactic antibiotic therapy since the micro vascularity of the bone is affected.(Aps, 2010)

V. CONCLUSION

Within the limitations of the current study, it can be concluded that the majority of the dental students were lack of awareness regarding radiation induced oral damage. The dental students have to be assessed more on radiation baseline to enhance their awareness and knowledge on this topic. In future scope, larger sample size with multi centered study has to be conducted to get a positive consensus for this study.

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CONFLICT OF INTEREST

The authors declare that there was no conflict of interest.

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