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Knowledge, attitude and practice of dental house surgeons and undergraduate students towards radiation safety and protection: A questionnaire based survey

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SUMMARY

Objective. Ionizing radiation is hazardous to living tissues due to their effects on somatic cells and genetic material. Since dental radiography is used widely for diagnosis, treatment planning and patient education, it is important for dentists to understand the problems associated with the use of radiation and the methods of preventing them. The present study was designed to assess and compare the knowledge, attitude and practice of dental house surgeons and undergraduate students towards radiation safety and protection.

Materials and methods. A cross sectional questionnaire based survey was conducted among 153 dental house surgeons and undergraduate students attending a dental teaching hospital.

Results. On comparison of the house surgeons with undergraduate students, the present study found that the knowledge, attitude and practice of house surgeons were better than the undergraduate students regarding AERB guidelines, ALARA principles, position distance rule, personal monitoring devices, thickness of lead barrier and use of lead protection. Both the groups had similar high knowledge regarding the harmful effects of X-rays. However undergraduate students had better knowledge regarding radiation hazard symbol and made better use of personal monitoring devices. A greater number of house surgeons were found to have had formal training in radiation protection while undergraduate students were more willing to undergo further training.

Conclusion. Dental students must be educated regarding radiation safety and protection before they commense work as independent practitioners for the protection of their patients, the environment and themselves.

Key words: radiation, X-rays, occupational safety, radiation protection.

INTRODUCTION

The transmission of energy via space and matter occurring in the particulate or electromagnetic form is known as radiation. Electromagnetic radiation can be of ionizing or non-ionizing type depending on their energy (1). Constant exposure to ionizing radiation occurs both in naturally occurring sources i.e. background radiation and man-made sources especially via medical procedures (2-4). Ionizing radiation results in production of free radicals that are chemically reactive as it has sufficient energy to remove electrons from atoms or molecules. X-rays are a type ionizing radiation (2). X-rays were discovered in 1895, following which they have played an indispensable part in dentistry beginning from the diagnosis, treatment planning and follow up along with a widespread application ranging from detection of early caries to more complex procedures such as precision implant planning (5, 6).

There are two types of biologic effects of radiation namely the deterministic effect and the stochastic effect. Deterministic effect is dose dependent and is based on a threshold dose where the severity of injury increases with dose above a threshold dose. Stochastic effect has no 'threshold' or 'safe' dose, hence proportionality to dose is seen with regards

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to the frequency of response but not the severity (1, 7). The effect of exposure to low dose radiation is primarily stochastic whereas exposure to high dose radiation leads to both deterministic and stochastic effect (1).

Repeated radiographic examinations over time lead to high cumulative doses even though a minimal radiation dose is used for dental imaging when compared to its medical counterpart. This exposes both the dentist and the patient to a high risk of stochastic effect (8). Hence, with this background, it can be concluded that knowledge of radiation protection and its practice plays a crucial role in dentistry (9). As clinical undergraduate students and house surgeons will be at a constant risk from radiation during their current and future practices, they should have adequate knowledge on biological hazards of radiation and various protocols for protection (8).

The aim of this study was to assess and compare the KAP (knowledge, attitude and practice) of Indian dental undergraduate students and house surgeons towards biological hazards of dental X-rays and appropriate radiographic protection protocols.

MATERIALS AND METHODS

A cross sectional study was performed with a structured questionnaire designed in English with a total of 25 questions to access and compare the KAP of dental undergraduate students and house surgeons towards radiation protection in a dental teaching hospital in the state of Karnataka, India.

The questionnaire was pre-tested, validated by experts and ethicists for content and face validation, and was designed to be self-administered. It consisted of 2 parts; the 1st part was designed to collect demographic data while the second part consisted of close-ended questions (yes/no/no comment and true/false/no comment). The questionnaire included seventeen questions on knowledge, three on attitude and four on practice of radiation safety by the participants. To ensure the anonymity of the study no identifying information were included.

Institutional ethical committee clearance was obtained prior to conducting the study (IEC Number: ABSM/EC/34/2020). 153 participants (80 undergraduate students belonging to the final year of bachelor's study and 73 house surgeons) were recruited for the study conducted over a period of one month. Participation in the study was purely voluntary.

Data collection Procedure

Informed consent was obtained from all the participants. All participants were briefed regarding the purpose of the study and were instructed on how to complete the questionnaire on a single day. They were given 15 minutes to complete the questionnaire and were informed that answering all the questions was mandatory. The undergraduate students filled the questionnaire during a regular class hour under the supervision of the investigators. For the house surgeons participating in this study, the questionnaire was distributed during their clinical posting at various specialties. The questionnaire was collected by the investigators immediately upon completion.

Data analysis

Following the completion of questionnaire, the data obtained was entered in Microsoft Excel (version: Microsoft Office 2013) and was subjected to statistical analysis. The data was analysed using SPSS software for descriptive statistics. They are expressed in terms of numbers and percentage.

RESULTS

A total of 153 (73 house surgeons and 80 undergraduate students) participated in the study out of whom 53 were males and 100 were females. 98% of both undergraduate students (UGs) as well as house surgeons were aware that X-rays were harmful. 52.5% of UGs and 94.5% of house surgeons were aware of the national and international guidelines regarding radiation doses but only 13.7% of UGs and 97.2% of house surgeons were aware of the ALARA (as low as reasonably achievable) principle. 36.2% of UGs and 69.8% of house surgeons were aware of the AERB guidelines for room design. 77.5% of UGs and 73.9% of house surgeons said that they were able to recognise the radiation hazard symbol. (Table 1, Figure).

61.2% of UGs and 97.2% of house surgeons were aware of the position-distance rule and 67.5% of these UGs and 86.3% of these house surgeons made use of the rule while making radiographs. 76.2% of UGs and 97.2% of house surgeons were aware of personal monitoring devices while only 23.7% of UGs and 16.4% of house surgeons made use of such devices. 12% of both UGs and house surgeons made use of lead aprons and thyroid collars while making radiographs. Although 17.5% of UGs and 39.7% of house surgeons were aware of the thickness of the lead layer required to offer adequate protection only 13.7% of UGs and 20.5% of house surgeons provided lead protection to their patients prior to making dental radiographs. Among the UGs, 93.7% made use of film holders, 12.5% held the film with their fingers and 25% asked the patient to hold

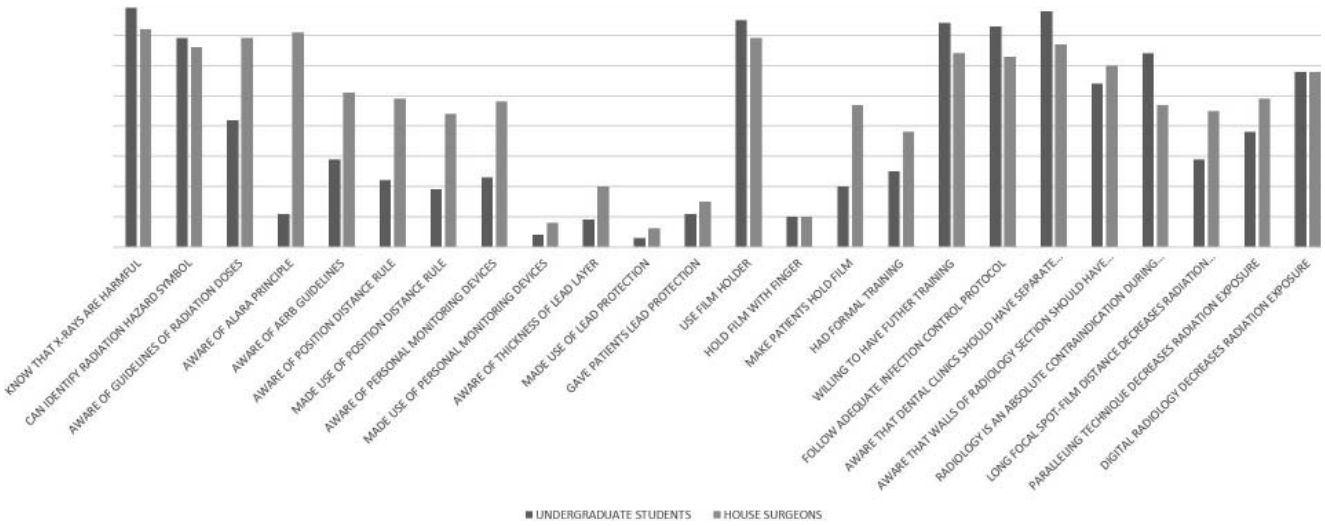

Fig. Graph showing the KAP of dental house surgeons and undergraduate students regarding radiation safety and protection

the film while making a dental radiograph. Similarly, among the house surgeons, 94.5%, 13.7% and 64.3% used these methods of film placement respectively. (Table 2, Figure).

31.2% of UGs and 52% of house surgeons had received formal training regarding radiation protection and 92.5% of UGs and 87.6% of house surgeons were willing to receive further training. 91.2% of UGs and 86.3% of house surgeons believed that they followed adequate infection control protocols while making dental radiographs. 97.5% of UGs were aware that dental clinics should have a separate radiology section but only 67.5% were aware that these sections should have protective lead barriers. The same was true for 92% and 82% of house surgeons respectively. 80% of UGs and 64.3% of house surgeons believed that dental radiographs were an absolute contraindication during pregnancy. Among the UGs and house surgeons, 36.2% and 61.6% respectively believed that long focal spot-target distance reduces tissue exposure, 76% and 67.1% respectively believed that paralleling technique caused less patient exposure when compared to bisecting angle technique and 72.5% and 79.4% respectively believed that digital radiography reduced patient exposure when compared to conventional radiography (Table 3, Figure).

DISCUSSION

As one of the principle diagnostic method in various fields of medicine, radiographic examination plays a vital role not only in the promotion of health for an individual but also at the environmental level (7). Even though dentistry has a relatively low radiation exposure to both patients and practitioners during diagnostic procedures, a special attention to radiation protection is recommended (3, 6).

In order to establish proper radiation protection protocols in clinical practise, dental students should have a detailed and empowering knowledge on biological hazards of X-rays. It is important that healthcare workers weigh the need for diagnostic X-rays against the possible radiation exposure to the patient. In order to provide protection for the patient, a necessary shift from the ALARA principle to ALADA (as low as diagnostically acceptable) principle must be done. Bearing this in mind, the present study was aimed towards the selected participants- the UGs and house surgeons to assess their KAP on radiation safety protocols.

Over 98% of the participants stated that they are aware that X-rays are harmful. These results are in an excellent agreement with a study conducted by Prabhat et al that shows nearly similar results as 100% of both UGs and house-surgeons opted that x-rays are harmful (9). Majority of the participants also stated that they can recognize the radiation hazard symbol. In contrast, Swapna et al in their study found that only 47.73% UGs and 67.5% house-surgeons were able to recognize the radiation hazard symbol (1).

In the present study it was found that a higher number of house surgeons had formal training regarding radiation safety and protection when compared to the UGs. It is heartening to see that most of the participants were willing to undergo further training regarding radiation safety and protection. Similarly, Behzadmehr et al also found that 60% of the participants had a positive attitude regarding radiation protection and safety (10). Absence of a threshold dose for stochastic effect places both the patient and operating personnel at high risk (9). Hence the aim of radiation protection protocol

Table 1. Table showing the KAP of participants regarding AERB guidelines and ALARA principles

	Undergraduate students	House surgeons
Know that X-rays are harmful	79	72
Can identify radiation hazard symbol	69	66
Aware of guidelines of radiation doses	42	69
Aware of alara principle	11	71
Aware of aerb guidelines	29	51

Table 2. Table showing the KAP of participants regarding dose minimization

	Undergraduate students	House surgeons
Aware of position distance rule	22	49
Made use of position distance rule	19	44
Aware of personal monitoring devices	23	48
Made use of personal monitoring devices	4	8
Aware of thickness of lead layer	9	20
Made use of lead protection	3	6
Gave patients lead protection	11	15
Use film holder	75	69
Hold film with finger	10	10
Make patients hold film	20	47

Table 3. Table showing the KAP of participants regarding techniques of exposure for radiation safety

	Undergraduate students	House surgeons
Had formal training	25	38
Willing to have futher training	74	64
Follow adequate infection control protocol	73	63
Aware that dental clinics should have separate radiology sections	78	67
Aware that walls of radiology section should have lead barrier	54	60
Radiology is an absolute contraindication during pregnancy	64	47
Long focal spot-film distance decreases radiation exposure	29	45
Paralleling technique decreases radiation exposure	38	49
Digital radiology decreases radiation exposure	58	58
Make patients hold film	20	47

should be focused on preventing the occurrence of deterministic effect and reduce the likelihood of stochastic effect by decreasing the exposure in dental office for both dental operating personnel and patients (1, 9). Hence, regulatory bodies at the international level like the ICRP (International Commission for Radiation Protection) and nationally in India, the AERB (Atomic Energy Regulatory Board) laid down the norms for radiation protection.(3) The fundamental principles of ICRP radiological protection namely, justification, optimization and dose limits application must be maintained (11). ALARA or ALADA principles should always be applied in all radiation exposure conducted in medicine (6).

AERB recommends norms for permissible doses of radiation from x-ray tubes, the shielding required for the walls of an x-ray tube room, the lead equivalent shielding apparel to be worn by radiation workers and lays down safe dose limits for radiation workers and for the general public (3). A majority of the participants in the current study were also aware that clinics should have a separate radiography room. However, the awareness regarding AERB guidelines for X-ray room design was relatively low. In the present study up to 77% of the participants are aware that X-rays can reflect off walls of the room but we found that both UGs and house-surgeons were lacking in their knowledge regarding protective lead barriers in radiology sections.

Throughout data collection, it was also evident that most of the participants were not aware of the thickness of the lead apron and only 12% of the participants used lead apron/ thyroid collars while making dental radiographs. Majority of the house surgeons were also aware of the position distance rule and made use of the rule while making dental radiographs when compared to their undergraduate counterpart.

Radiation monitoring is done to ensure that dose limits are not surpassed and to check whether protection measures are effective (2). When asked 'Are you aware of personal monitoring devices?' we found that although a large majority of the house surgeons answered yes, only 76.25% UGs knew about it.

Even more importantly, when asked 'Do you follow infection control protocol while making dental radiographs?' almost all of the participants said yes and this is a good sign to limit the likelihood of transmission of infectious disease to both the practitioner and the patient.

The data relating to knowledge of the participants observed in this study also suggests that there is disparity in clinical and theoretical knowledge between the two groups which can play a role in radiation safety & protection. This can be observed as house surgeons showed superior knowledge when compared to UGs regarding contraindication of radiation during pregnancy, focal spot-distance rule and use of digital radiography for reduction of patient exposure. Although bisecting angle technique is easier to use and more comfortable for the patients, it is universally accepted that paralleling technique gives better images and more importantly, makes the use of a film holder a must (9). It was seen that although UGs had a better understanding of paralleling technique to reduce patient exposure, due to practical constraints of catering to a large number of patients in a day, majority of the house-surgeons said that they made use of bisecting angle technique more than paralleling technique. This shows a shift in practicality of use of knowledge as their clinical career progresses. Similarly, Shabani et al also found that low clinical experience led to less practical information about radiation safety (12).

Film holders help the radiographers in film positioning and at the same time avoid unnecessary exposure to their fingers (6) The present study shows that most of the UGs use film holders while making dental radiographs. At the same time, it is alarming that most of the house surgeons let their patients to hold the film with their fingers while making dental radiographs. In a similar study conducted by Eman Ernaout 97.0% of the UGs and 97.7% of the house-surgeons made their patients to hold the film during exposure (8).

This study shows the need to reinforce the curriculum regarding radiation protection protocol. Since majority of the participants showed willingness to participate in additional training, dental schools must make provisions to train their candidates in radiation safety and infection control protocol before certifying them as independent practitioners. However, following the completion of this study, few limitations were observed. Firstly, a relatively small sample size was obtained as the survey was conducted only among the students in a single college in a single city. The designed questionnaire had more forced choice questions than open-ended questions which may have led to bias while answering. An additional study group consisting of post-graduate students could have been included in the study to compare their knowledge, attitude and practice with that of undergraduate students and house surgeons. This would give a comprehensive look into how much of knowledge on radiation safety and protection is retained as a student progresses in their academic career.

CONCLUSION

Ionizing radiation is hazardous to living tissues due to their stochastic as well as deterministic effects. The effect of radiation on somatic cells as well as genetic material raises questions regarding the safety of it's use. Since dental radiography is used widely for diagnosis, treatment planning and patient education, it is important for dentists to understand the problems associated with the use of radiation and the methods of preventing them. It is evident that students retain their knowledge regarding radiation safety and protection as they progress through their dental careers. Therefore, dental students must be educated regarding radiation safety and protection before they commence work as independent practitioners. Reiteration of this knowledge will help clinicians stay updated regarding new guidelines thereby ensuring continued protection of their patients, the environment and themselves. The results obtained from the present study can help in developing a well-rounded curriculum for dental education where emphasis is laid on the safe and judicious use of diagnostic radiation.

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