RADIATION PROTECTION IN THE DENTAL PROFESSION.

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INTRODUCTION

Prior to 1974, factories within Great Britain were subject to Regulations made under the Factories Act. Within teaching and research establishments, radiation was, broadly speaking, subject to non-enforceable Codes of Practice. In 1974 the Health and Safety at Work etc. Act was made; this sets the regulatory framework and it is enforceable within all premises where there are employed persons.

As yet no statutory provisions which relate to dental radiography have been made under this Act; these will be enacted in the near future as part of wider legislation to meet a Euratom Directive.

The Health and Safety Executive (HSE) initiated a survey in 1977 in order to acquire detailed information on the standard of radiation protection in dental practices. This stemmed, first, from the need for HSE to meet its enforcement duties, secondly, to devise a basis for regulatory requirements and, thirdly, to evaluate the dental postal pack provided by the National Radiological Protection Board (NRPB).

METHOD OF ASSESSMENT

The postal pack method of assessing the performance of dental X-ray sets was developed by the NRPB to enable relatively large numbers of X-ray sets to be checked cheaply. Its primary aim was to make it unnecessary for an experienced surveyor to visit each dental surgery, whilst retaining the capacity to collect all the information necessary to make recommendations regarding the compliance of the equipment and procedures with the accepted radiological protection standards. The system was designed to measure the linearity of output, the cone tip exposure rate, the beam diameter and an estimation of beam quality in terms of added aluminium filtration.

The method of assessment consists of two stages. Initially the dentist is asked to complete a questionnaire regarding the equipment, its operation and the radiographic procedures used in the practice. At the same time he is asked to expose three monitoring films at the tip of the X-ray cone for timer settings of 1.0 s, 0.7 s and 0.3 s respectively. From the exposures recorded on these films the linearity of output of the X-ray set is assessed.

On the basis of a tentative estimation of the output of the X-ray set, the dentist is sent specially developed cassettes for exposure at the tip of the cone for a specific timer setting which is designed to give an exposure of approximately 8 mGy. An X-ray film in the cassette is used to determine beam diameter and a standard personal monitoring film, behind filters, is used to measure the other parameters.

Added filtration is by far the most difficult parameter to measure. However, the apparent doses recorded on the personal monitoring film behind two copper filters and an unfiltered area can be used to estimate added tube filtration to an accuracy sufficient for radiological protection purposes. If the unfiltered to 0.48 mm Cu filter apparent dose ratio is plotted against the 0.1 mm Cu filter to 0.48 mm Cu filter apparent dose ratio, for a series of exposures made at various known tube filtrations and kilovoltages, a family of curves will be produced. Each curve represents a particular tube filtration value and an interpolation between curves can be made for exposures made on equipment whose tube filtration is not known.

Previous experience had shown that cone tip exposures in general are much greater than is necessary for the production of a good quality radiograph. A series of experiments with a phantom has revealed that for a given type of radiograph, there is a direct relationship between kilovoltage and the cone tip exposure required to produce a satisfactory radiograph (1). The 0.1 mm Cu to 0.48 mm Cu apparent dose ratio gives a good indication of operating kilovoltage and this is used to assess the cone tip exposure required for the production of a satisfactory radiograph. This exposure is then used as a basis for making recommendations regarding timer settings for different radiographic techniques.

Personal monitoring films were worn by dental staff during each of three consecutive months.

GUIDANCE TO PRACTITIONERS.

Dentists were chosen at random from a list of practitioners offering treatment within the National Health Service. Participation in the survey was voluntary. The standards against which each practitioner was evaluated were those set out in a Code of Practice (2), for medical and dental uses of ionising radiation. In 1975 all dental practitioners within Great Britain were issued with a synopsis of the Code (3) specific to dental radiography.

Following each assessment, recommendations are given, in writing, to practitioners to enable them to improve, or maintain, the quality of their radiographs while minimising the radiation dose to staff and patients.

The results presented here relate to two phases of the survey; Group A consists of the first 585 practitioners surveyed. Between the end of phase A and the commencement of phase B an effort was made to give additional guidance on radiation protection to the profession as a whole, this was based on the evidence from the Group A survey. The guidance consisted of a detailed article published in the professional literature (4), and a placard listing simple rules which was sent to all practitioners at the time of publication. Results from 194 Group B dentists are available to date. No member of Group B was a member of Group A.

SURVEY RESULTS

It is possible to give only a synopsis of the results in this paper:-

		Group A	Group B
(i)	Personal Radiation Dose to Dental Staff		
	Results from film badges worn for 1 month		
	< 50 µSv	82.3%	97.2%
	≥ 50 µSv but < 100 µSv	5.8%	1.6%
	≥ 100 µSv but < 200 µSv	7.1%	1.0%
	≥ 200 µSv but < 500 µSv	3.4%	0.1%
	≥ 500 µSv but < 1000 µSv	0.5%	0.1%
	≥ 1000 µSv	0.6%	0
(ii)	Beam Diameter		
	> 7.5 cms	12%	7%
	> 6.0 cms	55%	12%
(iii)	Beam Filtration		
	< 1.5 mm Al	11%	13%
(iv)	No "X-rays on" warning signal	9%	5%
(v)	Dental staff holding film or tube head	20%	7%
(vi)	Dose per exposure		
	≥ 6.6 mSv*	57%	54%
	≥ 5.0 mSv	76%	70%

* Experimental work (1) has indicated that, depending on the kilovoltage of the equipment, a good radiograph should be obtained with exposures of between 1.3 mSv and 6.6 mSv as measured at the cone tip.

Further information derived from the survey included other important factors such as film processing techniques, timer accuracy and reproducibility, location and maintenance of equipment and the level of instruction and supervision given to dental staff.

CONCLUSIONS

Comparison of Group A with Group B tends to indicate an improvement in standards. This may be partially due to the general educative campaign; it may result from discussion within the profession prompted by the HSE Survey programme. Another possibility may be two "natural phenomena", these being the ageing of equipment and the ageing of dentists. In the former, old equipment is replaced by equipment which should meet present technical standards. As dentists retire they are replaced by dentists who have recently completed their formal education, it is the latter who are, generally speaking, more appreciative of the hazards and of correct radiographic procedure.

It is anticipated that the standard in the practices of Groups A and B will further improve when individual recommendations, based on survey results, have been implemented.

The postal method of survey, reinforced, where necessary, by visits from inspectors, is a cost effective method of promoting radiation safety for dental staff and is a useful aid to the enforcement of statutory requirements. Early results are encouraging; it is intended to resurvey each dental practice every 6-7 years and it is clear that the enforcing authorities must maintain contact with the suppliers of dental radiographic equipment and with the dental schools.

REFERENCES

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