Aspects of panoramic radiography in general dental practice

V. E. Rushton,[1] K. Horner,[2] and H. V. Worthington,[3]

Objectives To gather information on the types of panoramic x-ray equipment used in NHS dental practice and whether dentists satisfy the legal requirements for safety, to determine which practice personnel take panoramic radiographs and to assess the prevalence of the practice of 'routine' panoramic radiography among NHS dentists.

Design Postal questionnaire survey of general dental practitioners carried out during 1997 in selected FHSAs in England and Wales.

Results 542 dentists returned the questionnaire, a 73.3% response. Panoramic x-ray equipment ranged in age from 27 years old to new, with 42.2% exceeding 10 years in age. The overwhelming majority of GDPs satisfied the requirement for regular maintenance and surveying of equipment. Almost all dentists (95.9%) performed a history and clinical examination prior to panoramic radiography but 42% practised 'routine screening' of new adult patients. A substantial proportion (36.7%) of dentists used unqualified personnel to take panoramic radiographs.

Conclusions While some aspects of this study give reassurance about the prevalence of good practice, widespread panoramic screening and using unqualified staff to take radiographs causes concern. These findings have implications for educators and for those involved in maintaining clinical standards.

All types of radiography in England and Wales have shown a steady rise throughout the past two decades, with a marked proliferation in the use of panoramic radiology. In 1983, Wall and Kendall remarked on the rapid rise in its use,[1] while today more than 1.7 million panoramic radiographs are taken annually in NHS general practice.[2] These figures underestimate the true numbers as they exclude radiographs exposed in independent practices, hospitals and the Community Dental Services. Recently it was estimated that there are about 3,250 panoramic x-ray sets in the UK.[3]

While any exposure to x-rays is believed to carry a risk of inducing cancer, dental radiography has generally low doses and associated risks. Nevertheless, the dose from panoramic radiography has recently been estimated at 6.7 μSv,[3] and 26 μSv,[4] carrying an associated risk of inducing a fatal cancer of 0.21 and 1.9 cases per million examinations respectively.[3,4] Such dose and risk levels assume a level of 'good practice' and well-maintained modern equipment. However, higher doses and risks are associated with certain older types of equipment. Those using a circular scanning motion incorporating three centres of rotation produce doses between 3 and 16 times higher than those with an elliptical path of rotation, due to relative 'hot spots' over the mandible and parotid glands.[5] A study in France showed the latter type to be the most widely used.[6] Furthermore, a survey of panoramic equipment in the UK found that a higher dose than appropriate was being delivered during use of 70% of the panoramic equipment.[7]

It is a fundamental requirement of radiation protection that all exposures to x-rays as part of diagnosis should be clinically justified for each patient. The guidelines on the use of 'panoral' radiographs devised by the Dental Estimates Board in 1983,[8] are in conflict with this philosophy. One of these guidelines states that a fee would be paid by the Board for a panoramic examination for 'Examination of a patient new to the practice, or for a patient for whom a comprehensive radiographic examination has not previously been undertaken at the practice'. There is no evidence to support 'routine' panoramic radiography of patients, and a recent report has recommended selection criteria for use of the technique in primary dental care.[9]

The Ionising Radiation Regulations (1988)[10] and the Guidance Notes[11] put certain obligations upon dentists. It is a requirement that all x-ray equipment is regularly maintained and surveyed every 3 years for radiation safety,[11] but it is not known how many dentists comply with these requirements. A 'physical director' (the person who exposes the patient) must be adequately trained,[10] but anecdotal evidence of nurses and other practice staff taking radiographs suggest that this requirement is not always observed.

While there is some valuable data in existence on the radiation doses delivered during panoramic radiography,[1,3–6] there is little information available on other aspects of panoramic radiographic use in the UK.

The objectives of this study were:

1. To gather information on the panoramic equipment used in NHS dental practice and whether dentists satisfy the legal requirements for safety
2. To determine which practice personnel take panoramic radiographs
3. To assess the prevalence of the practice of 'routine' panoramic radiography among NHS dentists.

Material and methods

The study involved a postal questionnaire of dentists working in 22 Family Health Service Authorities (FHSAs) in England and Wales during 1997. Dental Practice Board data[12] on the rates of claims for radiographs per 100 item of service claims classify each FHSA as a 'low', 'medium' or 'high' prescribing area (hereafter termed the 'radiographic prescription profile'). FHSAs were randomly selected from each of the three category groups for inclusion in the study. The number of FHSAs included from each category was determined on the basis of numbers of registered dentists in those FHSAs, so that approximately equal numbers of dentists were surveyed from each of the 'low', 'medium' and 'high' prescribing areas.

Current lists of GDPs working in the FHSAs were obtained and

[1]*Lecturer in Dental and Maxillofacial Radiology,* [2]*Senior Lecturer in Dental and Maxillofacial Radiology,* [3]*Senior Lecturer in Dental Statistics, Department of Dental Medicine and Surgery, University Dental Hospital, Manchester M15 6FH*

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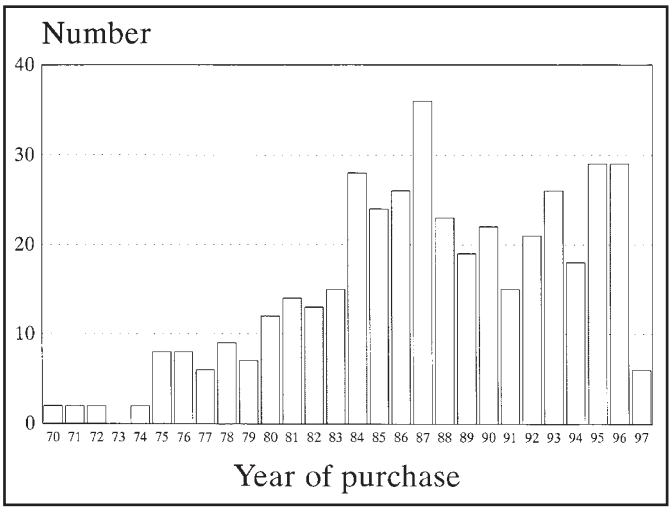

Fig. 1 The year of purchase of panoramic radiographic equipment belonging to the dentists in this study; 42.2% of equipment was greater than 10 years old (data obtained from a study conducted in 1997).

each GDP contacted by telephone to ascertain whether their practice possessed a panoramic radiography machine. The 819 GDPs giving a positive response were then circulated with the questionnaire and a reply-paid envelope. A second mailing was sent to non-responders after 3 weeks. Those GDPs who had not responded to the second mailing were contacted by telephone after a further 2 weeks and, where necessary, a third copy of the questionnaire sent. The secretarial staff involved in the day-to-day organisation of the study allocated numbers to each GDP to ensure anonymity and therefore confidentiality to the participants.

The questionnaire requested a range of information on basic dentist and practice details, and details of the equipment and method of processing used in the practice. Three specific questions relating to the use of panoramic radiography were also asked:

1. Was a history and clinical examination performed prior to using panoramic radiography?
2. Was it normal practice to take a panoramic radiograph of every new adult (18 years and over) patient?
3. Who usually exposed the panoramic radiograph ('pressed the button')?

The resulting data were analysed using the *SPSS PC+ system.*[13] Data were analysed for all GDPs and then separately for dentists grouped according to the radiographic prescription profile of their FHSAs ('high', 'medium' or 'low' prescribers) and according to age group. Pearson chi-squared tests were carried out to detect differences between groups. All comparisons were undertaken at the 0.05 level of significance.

Results

This study was carried out during 1997. Completed questionnaires were returned by 542 GDPs. A total of 58 GDPs originally circulated were subsequently found to have been unavailable to respond (50 GDPs had moved practice, six had retired from practice and two were on long-term sick leave). Excluding these 58 non-responders, the overall response to the questionnaire was 73.3%. There were approximately equal numbers of GDPs in each of the three 'radiographic prescription profile' groups (low: 187; medium: 178; high: 177).

Male dentists comprised 77.4% of responders. GDPs working in multiple-dentist practices comprised 88.5%, the remainder working as single-handed practitioners. Most GDPs (76.4%) worked entirely or predominantly within the NHS. The majority of GDPs (66.9%) qualified prior to the introduction of the Ionising Radiation Regulations (1988).

Only 54% of GDPs had attended a course on radiation protection during the previous 7 years. Sixty-one per cent of the dentists who had qualified prior to 1988 had been on such a course, compared with 42% of younger dentists, significantly different percentages ($P < 0.001$). Over a quarter (26.5%) of GDPs worked with ancillary staff (nurses or hygienists) who had attended a recognised training course and examination in radiography.

The panoramic equipment used by the GDPs had been installed between 1970 and 1997, with under half (42.2%) being greater than 10 years old (fig.1). Dentists qualified prior to 1988 were significantly more likely to use equipment over 10 years old ($P = 0.012$). The majority (94.8%) of equipment had been serviced during the previous 3 years, and 99.2% of equipment had been surveyed for radiation safety during the same period. Processing of panoramic radiographs was performed using automatic processors by 75.1% of GDPs.

The overwhelming majority (95.9%) of GDPs performed both a history and clinical examination prior to performing panoramic radiography of a new adult patient. Of the remainder, 2.4% only carried out a history, 0.6% only a clinical examination and 1.1% carried out radiography without either being performed. Forty-two per cent of GDPs routinely performed panoramic radiography of every new adult patient attending their practice. When 'routine' panoramic radiography was considered in relation to FHSA 'radiographic prescription profile', this percentage rose to 51.7% for GDPs in high prescribing FHSAs, significantly greater than in medium (35.1%) or low (39.6%) prescribing areas ($P = 0.005$). There was no significant difference in the percentages of dentists who practised 'routine' panoramic radiography between those qualified before and after 1988. However, a significantly smaller percentage of GDPs whose practice was wholly or predominantly NHS carried out routine radiography ($P = 0.003$).

Analysis of responses to the question '*who usually exposes the panoramic radiograph?*' revealed that in 47% of cases the answer was the dentist. In 39%, the radiography was carried out by the nurse or hygienist, and in 1.7% of responses the receptionist was named as the person performing the examination. In the remaining 12.3% of cases the responses gave various combinations of staff as sharing the role of radiographer. Not surprisingly, dentists who employed a member of ancillary staff who possessed a recognised qualification in dental radiography were significantly more likely to delegate taking of panoramic radiographs ($P = 0.001$). Dentists qualified prior to 1988 were more likely to have qualified staff whose duties included taking the radiographs ($P = 0.035$). Dentists qualified after 1988 were more likely to take the radiographs themselves ($P = 0.028$) By cross-tabulation of responses relating to who takes panoramic radiographs and ancillary staff training, it was possible to identify that 36.7% of dentists used unqualified staff to take panoramic radiographs. In this respect there was no difference between GDPs qualified before and after 1988.

Discussion

The response rate to this questionnaire study was satisfactory, being at the upper end of the typical response rate for dental surveys. Difficulties are encountered in a study of this type where there is a reliance upon FHSA lists which, having been complied on an annual basis, may not accurately mirror the current composition of local dentists. Furthermore, the lack of an FHSA number for vocational trainees and those GDPs involved in totally independent practice precluded their inclusion in the survey.

The age range of equipment used in general practice was very wide, with most being over 10 years old. However, only a very small proportion of dentists had omitted to carry out routine maintenance and a radiation survey in the previous 3 years. Older equipment, even though regularly maintained, may be associated with higher radiation doses than are currently achievable with new

equipment and may not include such developments as selective collimation, DC-circuitry and positioning aids which reduce doses and improve quality.[14] Of course, the mere fact that equipment is old may not indicate the need for replacement, particularly in an NHS practice where minimisation of costs is a major consideration. Nevertheless, it is important to realise that doses and risks associated with the use of such equipment may be higher than the reassuringly low figures recently publicised for 'state of the art' machines.[3]

The requirement that all x-ray exposures for diagnostic purposes must be clinically justified imposes the implicit need for dentists to perform a preliminary history and clinical examination. Only a small number of GDPs admitted failing to comply with this, a result in almost exact agreement with a previous study of British dentists dealing with bitewing radiography.[15] This finding is in stark contrast to a study in North America,[16] where radiography was carried out before a full history and clinical examination in 38.7% of cases. In this respect the results of the survey are reassuring.

It can be interpreted that the Dental Estimates Board guidelines on the use of 'panoral' radiographs implied an acceptance of 'routine' panoramic radiography for all new adult patients, a practice performed by 42% of GDPs in this survey. 'Routine screening' panoramic radiography has been questioned on ethical and scientific grounds in recent years,[3,5,17,18] a view reinforced by new evidence-based guidelines on the use of radiography.[9] The results of this survey suggest that a substantial minority of dentists perceive routine radiography to be useful and that current arguments against routine screening are either not known or not accepted. This finding has implications for teachers at both undergraduate and postgraduate levels. However, it is tempting to surmise that the initial financial outlay of purchasing panoramic equipment acts as a factor favouring the taking of radiographs as a means of recouping costs.

It was, however, interesting to identify a difference in the percentages of dentists whose usual practice is to radiograph routinely all new adult patients when those from radiographically 'high' prescribing' FHSAs were compared with the others. While it is possible that this may reflect poorer dental health in the 'high' prescribing FHSAs influencing dentists to take radiographs, further work would be needed to determine the strength of any relationship between local prevalence of dental diseases and radiographic prescription. Previous work on bitewing radiography has identified that dentists are influenced in radiographic prescription by individual patient risk factors,[19] but that they may also be influenced in other ways which should not affect prescription (eg patient demands, pregnancy, medico-legal reasons). It is similarly difficult to explain why 'routine' panoramic radiography of new patients was performed by a smaller percentage of dentists working wholly or predominantly within the NHS compared with that of dentists working predominantly in independent practice. Perhaps this reflects a difference in treatment philosophy, with independent dentists aiming to provide absolute assurance that all dental disease has been detected. If so, such a view is contrary to the evidence against the practice of 'screening' radiography, and third party healthcare payment agencies should be careful not to condone such a practice.

It is a requirement of the Ionising Radiation Regulations[10] that both the clinical and physical directors of an x-ray examination should be formally trained in the theoretical aspects of radiation protection. The current undergraduate dental and hygienist curricula recognise this, while a course in radiography for qualified dental nurses has been recently devised to address specifically this need. In this study, we identified those dentists who had attended a certification course on radiation protection in the past 7 years because recent guidance[3] suggested such an interval between regular 'updating' of knowledge. However, bearing in mind that more recently qualified dentists are likely to have received instruction in radiation protection as part of their undergraduate curriculum, the most important group to consider were those qualified before 1988, the year in which current legislation[10] and guidelines[11] were introduced. The substantial minority (39%) of these older dentists who had not been on a course causes some concern, even bearing in mind the known limitations[20] of such forms of continuing education.

The results of this survey showed that over one third of the dentists surveyed used unqualified ancillary staff to take panoramic radiographs. Indeed, a small number of GDPs used reception staff as radiographers. The question to be answered by the profession is whether it is the statutory guidelines that are unrealistic or the dentists who are at fault. On the one hand, it can be argued that panoramic radiographic equipment is rarely positioned by the chairside and its use is more conveniently delegated to others in the practice; on the other hand, anecdotal reports of poor quality of the panoramic radiographs produced in the dental practice may be interpreted as indicating a need for properly trained operators. Bearing in mind the large number of panoramic radiographs performed annually in dental practice, there is a need to identify whether there is any relationship between the quality of radiographs and the nature of the training undergone by the operator of the equipment.

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