X-RAY GUIDANCE FOR CHIROPRACTORS

UK Regulations for Ionising Radiation

All use of ionising radiation is regulated by the Ionising Radiations Regulations 1999 (IRR99)

The object of IRR99 is to ensure, by placing duties on employers, that every use of ionising radiation at work is justified and optimised, and in particular that any exposure of people (whether employees, patients or members of the public) is justified, optimised, subject to dose limits and as low as reasonably practicable

IR(ME)R procedures for chiropractic radiography

Every Employer is required to establish and maintain procedures that define how every aspect of his operation (apart from matters of professional judgement) that may affect a patient's exposure to ionising radiation, is carried out. These generic draft procedures cover most of the requirements for chiropractic radiography. The apparent convolutions are due to the fact that IR(ME)R requires any person acting in more than one capacity (as employer, referrer, practitioner or operator) to carry out the all the duties applicable to each capacity. For most single-handed practices "this means you".

1. The Employer, for the purposes of the Ionising Radiations Regulations, is ..... Any registered chiropractor employed in a direct or locum capacity, is entitled to act as Referrer, and if qualified in chiropractic radiological examination, as Practitioner and Operator. The names of such employees, and others entitled to act in specific capacities, are listed in an appendix to these Procedures. The following procedures are the Employer's Procedures required by Schedule 1 of the Ionising Radiation (Medical Exposure) Regulations 2000.

2. The Employer's referral criterion is that any patient who in the opinion of the Referrer is likely to benefit from x-ray examination may if he consents be referred to the Practitioner for x-ray examination.

3. Referrer: Make written clinical notes in the patient's record sufficient to permit yourself in your capacity as Practitioner to justify any x-ray exposure which in your capacity as Referrer you may consider appropriate to the patient's treatment.

4 Practitioner: Consider the data which you have provided to yourself and decide whether in the light of the specific objectives of the exposure, the characteristics of the patient, the total potential benefits to society and the patient, the individual detriment that the exposure may cause, and the efficacy risks benefits and availability of alternative techniques, whether to justify the exposure.

5. Practitioner: Ask and record the date of the last menstrual period of any female patient, and invite her to sign the declaration that she is not pregnant. If she says she is pregnant, or is not certain, explain the "28-day rule" and invite her to sign consent to x-ray examination if in your opinion the benefits of such examination will outweigh the risks arising from it. A patient who has missed a period may not be x-rayed in this practice unless she signs the declaration that she is not pregnant. A patient who is unwilling to sign the declaration or consent may not be x-rayed in this practice. An x-ray consent form template is attached at **Annex A**

6. Whilst there is no statutory requirement to record the Practitioner's justification, the Employer requires the Practitioner to use the "tick list" or write in the reasons for proceeding to x-ray examination, on the patient record form, for statistical purposes.

7. Practitioner: If the exposure is justified, authorise the exposure by signing the appropriate box on the x-ray record form.

8. Practitioner: Ask the patient to check that his/her name, date of birth and address are correctly recorded on the x-ray record form. Hand the form to the patient to give to the Operator, if you are not the Operator.

9. Operator: Refer to the exposure chart to select appropriate technique factors, record the projection and factors for each exposure in the journal against the patient's name, and initial the entry. Standard projections used in this clinic are referred from the textbooks held in..... Optimise each exposure in keeping with good professional practice regarding positioning collimation and patient instruction.

10. Operator: Ensure that the patient's name and date of birth, exactly as written on the x-ray record form, and the date of the exposure, are recorded on every film.

11. Operator: Ensure that the film stock is compatible with the screens in use and is in date; that the chemicals are properly stored, in date, and prepared according to the manufacturer's instructions; and that the processor is cleaned and maintained according to the manufacturer's schedule, adequately warmed up and cleaned before processing any clinical films, and is subjected to regular quality control.

12. Operator: Process films immediately after they are exposed. Reload the cassettes and replace them correctly.

13. Operator: Use pre-exposed test films as directed, to test the processor. Initial, date and file each test film. If the test film is not within the normal range, you must prevent further use of the x-ray equipment, investigate, correct and repeat the test. Do not allow anyone to process any clinical films until you are satisfied that the processor is working correctly. If in doubt, consult the Radiation Protection Supervisor named in the Appendix.

14. Operator: Hand all the processed films to the relevant Practitioner as soon as possible, including any rejects.

15. Practitioner: Read and report every film. "NAD" or "Normal" is unlikely to be true in the case of any patient presenting for chiropractic examination and treatment. If there is No Visible Contraindication to manipulative treatment and no other outstanding pathology to report, record "NVC" as a minimum. Sign and date the report.

16. Practitioner: medico-legal and other "third party" referrals may be accepted from Referrers who have established specific contracts with the Employer. The terms of each such contract are held by the Employer to whom reference must be made if the Referrer is not familiar to you.

17. Practitioner and Operator: third party referrals are considered to have been justified and authorised by the Referrer acting in the capacity of Practitioner but good practice requires that you should carry out relevant parts of these Procedures from 5 onwards and record your actions.

18. Practitioner: Once a month, review the Operator's journal and check whether exposure factors for similar projections of similar patients have altered from those delivered a month and a year earlier. If not, it may be presumed that patient doses remain in line with the diagnostic reference levels (DRLs) for this practice. The DRLs adopted are those set out in the current edition of the British Chiropractic

Association's Guidance Notes. These are expected not to be exceeded when good and normal practice is applied. If you suspect that doses have increased, contact the Employer or the Medical Physics Expert whose name appears in the Appendix to these Procedures.

19. Operator: Report any suspected malfunction or irregularity in equipment or materials to the Employer immediately.

20. All personnel: The most significant cause of excess patient dose in hospital practice is "lost films". One of the legal requirements of the Code of Practice published by the General Chiropractic Council is that x-rays taken or ordered by a Chiropractor must be retained by the Chiropractor as part of a patient's health record. Under the Data Protection Act patients are entitled to a copy of their x-rays, which a Chiropractor may make reasonable charge. **See Annex D.** Do not permit any person to remove the original films from the practice.

Patient Exposure Record

One key to compliance with IR(ME)R is to ensure that you have recorded all the essential data from a patient episode. A simple record of the details of every exposure, is invaluable for quality assurance and as a means of estimating individual patient doses. An exposure log template is enclosed at **Annex B**.

After identifying the patient, the most important column from a legal point of view is for the operator's initials. In a multi-handed practice, or if you employ a locum, you must be able to identify the person who took each film.

With a glance at a well-kept log, you can estimate your radiographic workload. Is your film turnover too low to keep the stock fresh? Consider reducing the number of sizes of film you use: 18 x 43 cm may save money of you take 200 lateral lumbar films per year, but if you take less than 50, you may be throwing away unused film, or compromising image quality with stale film.

Once a week, compare the factors you used for an average male PA lumbar spine, with those you used a week, a month, and a year ago. If the mAs has increased, perhaps the developer temperature has decreased. If the kV has changed, there may be a fault in the x-ray generator.

Using the recorded factors for a given exposure, and the "specific output" chart in your x-ray unit's latest inspection report, you can estimate patient skin dose. Your physics adviser will need this data if you have to counsel a patient who discovers she is pregnant after you have x-rayed her, and you should be able to demonstrate compliance with consensus norms for any particular examination.

date	name	exam	cm	kV	mA	s	ffd
12/12/03	John Smith	APLx	25	80	200	0.2	150

"ffd" - "cm" (patient thickness) = focus-skin distance : 125 cm in this instance

the specific output chart shows, say, 20 microgray/mAs at 100 cm for an 80 kV exposure (this is a typical value for modern generators). In this case we have used 200 x 0.2 = 40 mAs, giving a dose "in air" of 800 microgray at 100 cm.

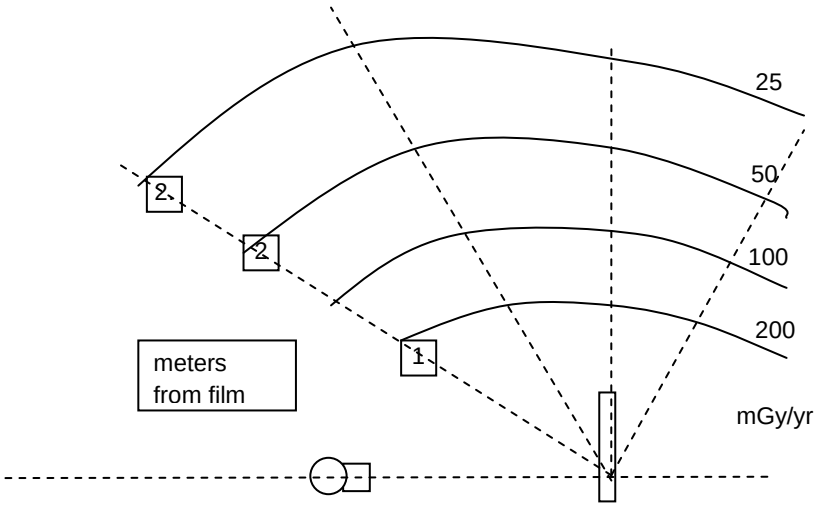
Applying the inverse square law, the dose incident on the patient at 125 cm would be 800 x (100/125) x (100/125) = 512 microgray - well within the EU diagnostic reference level.

Information on how to use the radiographic exposure universal chart is attached at **Annex C**

X-ray room design: risk assessment

A prior risk assessment must be carried out, and design constraints set, before designing any radiation facility. In the case of chiropractic radiography, the universal diagram below highlights the scattered radiation from a "worst case", say 2000 radiographs per year at 100 kV, 100 mAs, 150 cm focus/film distance, at various distances and angles from the centre of the film. This has been derived from a seminal paper (Trout & Kelley, Radiology 104: 161-169 (1972)) and adjusted for common UK chiropractic radiography practice.

Assuming a workload of 2000 exposures/year at 100 kV, 150 mAs, 150 cm ffd, the scattered radiation from a chiropractic x-ray system has roughly the following polar characteristics



Scattered radiation polar plot (after Trout & Kelley)

The unattenuated primary beam would deliver about 20 Gy/yr in the plane of the bucky.

The Ionising Radiations Regulations require that no person (other than a patient) should receive an effective dose in excess of 1 mSv/year resulting from the use of ionising radiations at work. Good practice requires that we should design for worst-case doses of not more than one tenth of this limit: an exit dose of 0.1 mGy/yr at any point is a practical design constraint.

The transmission of 100 kV x-rays through

1 mm lead	is roughly	4×10^{-3}
Code 3 (1.32 mm) lead		1.2×10^{-3}
Code 4 (1.8 mm)		4×10^{-4}
Code 5 (2.24 mm)		1.5×10^{-4}
Code 6 (2.65 mm)		4×10^{-5}
120 mm brickwork		4×10^{-3}
240 mm		5×10^{-5}
PFA breeze block		1×10^{-2}
100 mm concrete		5×10^{-3}
200 mm		7×10^{-5}
300 mm		1×10^{-6}
12 mm barytes plaster		7×10^{-4}
18 mm		8×10^{-5}
25 mm		1.2×10^{-5}
½ -hour fire retardant door		0.8
Wood/plaster ceiling and floor		0.2
12 mm gypsum plasterboard		0.5
10 mm plate glass		0.3