Public Health England

Practical optimisation of patient doses

What is optimisation?

Optimisation is a balancing act : image quality vs patient dose.

- Dose too low: undiagnostic image, repeat exposure
- Dose too high: diagnostic image (perhaps), but at increased risk to patient
- Dose just right: image quality ‘adequate’ for diagnosis or treatment planning = optimisation

How can you achieve this in practice?

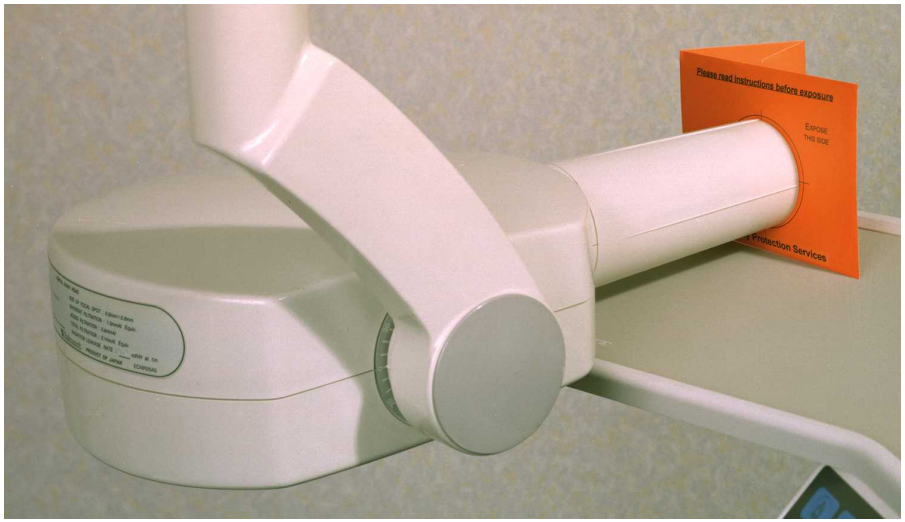
X-ray equipment

Dental GNs, Chapter 4 covers

- X-ray equipment and how it affects optimisation
- ancillary equipment and how it affects optimisation
- how equipment should be ***used*** to achieve optimisation
- table 4.1 summarises where to find the guidance

Topic	Brief description of requirement	Relevant section of this guidance
Operation of X-ray equipment	Operators to select the most appropriate X-ray equipment, radiographic technique and appropriate protocol (including collimation and field of view where relevant) in order to keep patient dose ALARP; for	
	• Intra oral X-ray equipment	4.3.1
	• Hand-held dental X-ray equipment	4.3.2
	• Panoramic and cephalometric equipment	4.3.3
	• Dental CBCT equipment	4.3.4
	• Image receptors	4.3.5
Use of patient contact shielding	Protective aprons and thyroid shields are not recommended for routine use on patients.	4.4
	• Display screens should meet the recommended standard • Specially-designed light-boxes should be used to view film radiographs • Attention should be paid to the adequacy of the viewing conditions for all dental radiographs or dental CBCT images	4.2

Intra oral: effect of collimation



Circular

6 cm diameter

beam area = 28.3 cm^2

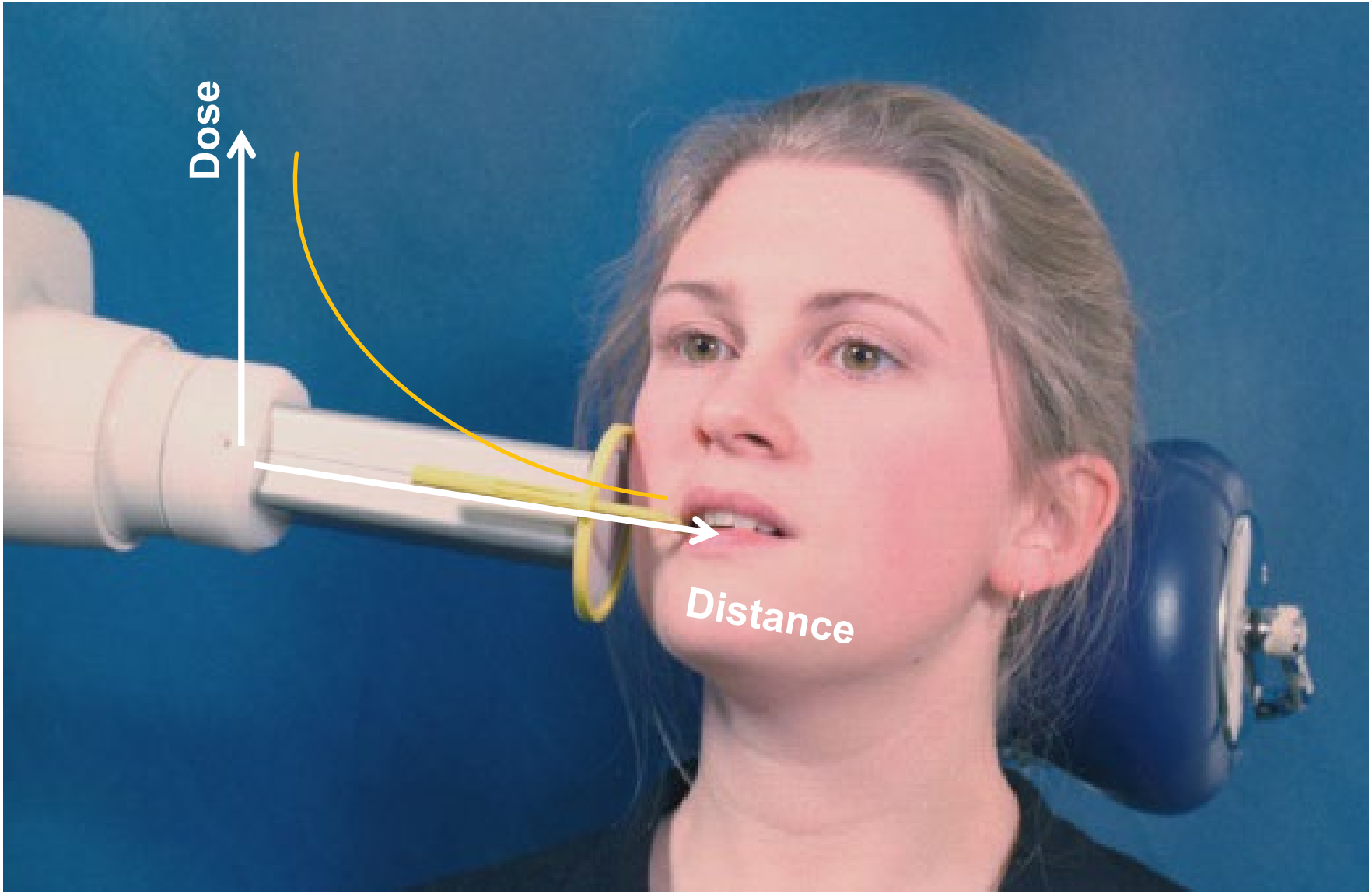
Rectangular

3.5 x 4.5 cm

beam area = 15.75 cm^2

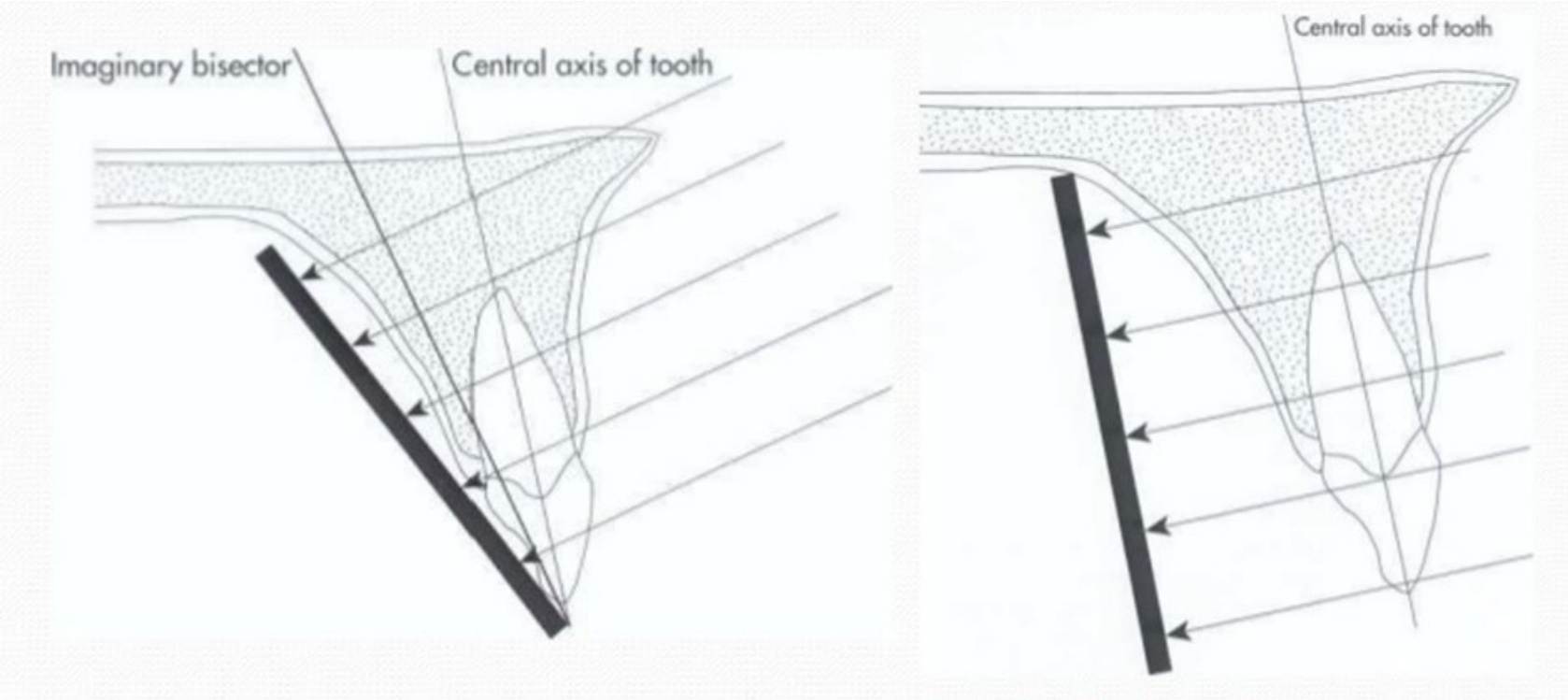
Intra oral: effect of collimation

Intra oral: effect of focus to skin distance



Intra oral: effect of technique

Bisecting angle vs Paralleling technique



Intra oral: effect of imaging system

Imaging system	3rd quartile patient entrance dose, mGy*†
D-speed film	1.9
E-speed film	1.4
E/F-speed film	1.2
F-speed film	1.3
Computed radiography (CR)	1.1
Direct radiography (DR)	1.0

*The patient doses were measured at the settings normally used for an adult mandibular molar radiograph

† Source: PHE-CRCE-59: Dose to patients from dental radiographic X-ray imaging procedures in the UK - 2017 review

Intra oral: selection of exposure settings

Operating potential

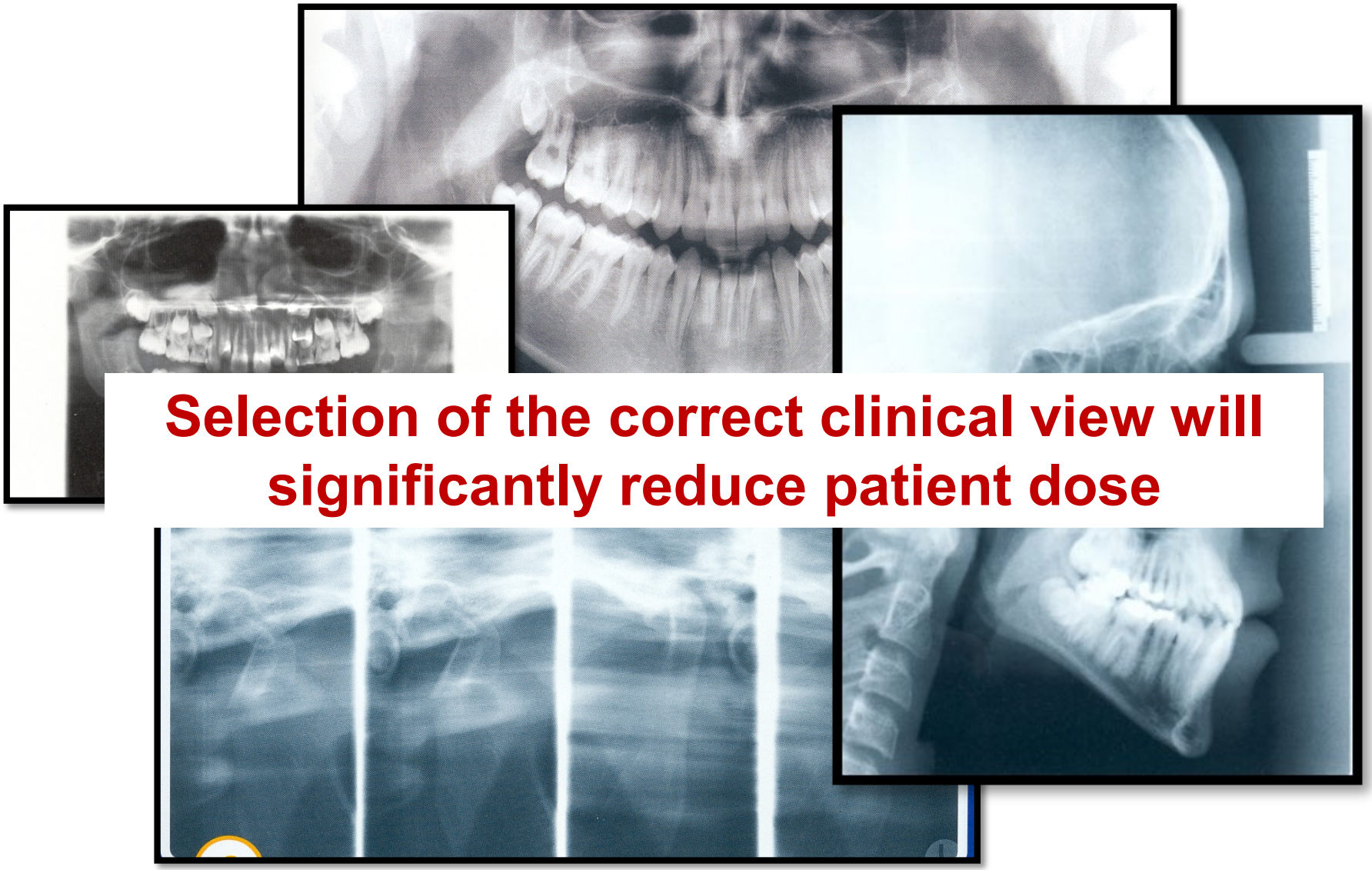
- using 70 kV rather than 60 kV results in about 25% less patient dose

Tube current (mA) and exposure time must be well-matched to:

- the imaging system used
- anatomical view
- patient size

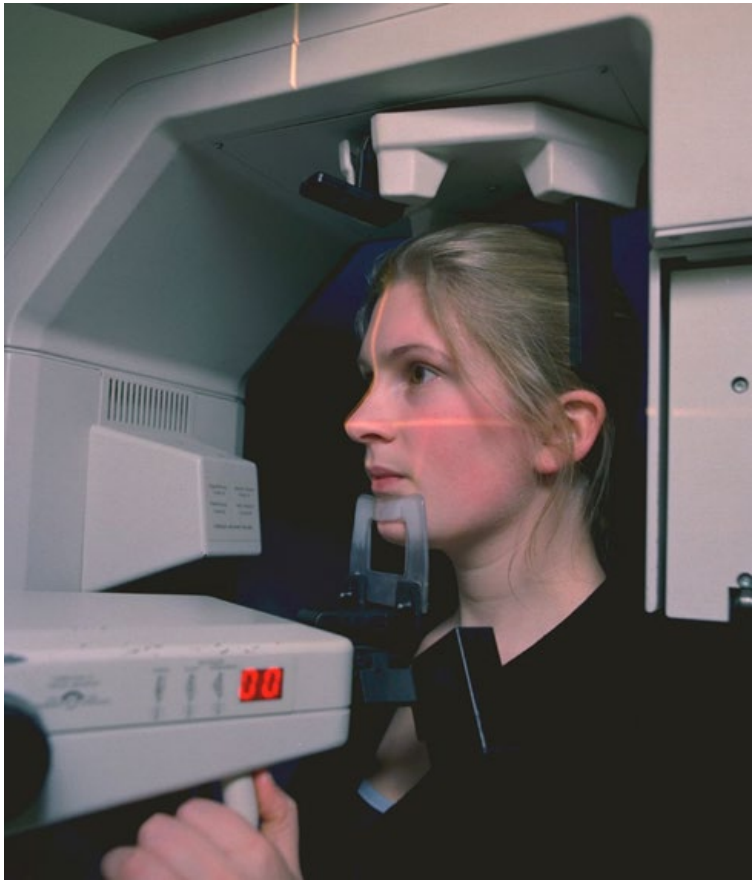
Intra oral: hand-held X-ray sets

Panoramic and cephalometric: collimation



Selection of the correct clinical view will significantly reduce patient dose

Panoramic and cephalometric: positioning



Panoramic: effect of imaging system

Imaging system	3rd quartile dose area product, mGy cm2*†
Film	82
CR	80
DR	81

*The patient doses were measured at the settings normally used for an standard adult panoramic radiograph

† Source: PHE-CRCE-59: Dose to patients from dental radiographic X-ray imaging procedures in the UK - 2017 review

Cephalometric: effect of imaging system

Imaging system	3rd quartile dose area product, mGy cm²*†
Film	39
CR	46
DR - static	69
DR - scanning	23

*The patient doses were measured at the settings normally used for an adult lateral cephalometric radiograph

† Source: PHE-CRCE-59: Dose to patients from dental radiographic X-ray imaging procedures in the UK - 2017 review

Dental CBCT: collimation

- Only the region of clinical interest should be imaged
- The whole imaged volume should be reported on
- Dentists may not report on anatomy outside the dento-alveolar region (without additional training)

Selection of the correct clinical view will significantly reduce patient dose

Dental CBCT: other factors

As for panoramic and cephalometric equipment

- Patient preparation
- Patient positioning – including use of scout views
- Patient instructions
- Correct exposure factors (patient size etc)

Other factors that could reduce patient dose for dental CBCT

- Use lower exposure factors where possible (mA, time, voxel size, resolution settings)
- Partial rotation scans
- Partial volume reconstructions (to omit artefacts caused by metallic restorations etc)

For more information on optimising patient doses in dental CBCT, please refer to chapter 4 of the Dental GNs

Optimisation of patient dose – all equipment

And don't forget these, which also support optimisation:

- Routine checks on condition of X-ray equipment (arm counterweights, tubehead etc)
- Servicing as per manufacturer's recommendations
- Routine performance tests on X-ray equipment
- Compliance with any local or national DRLs
- QA for digital equipment (plates, sensors, readers, display screens)
- QA for film processing, darkrooms, lightboxes
- QA of viewing conditions