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حفاظت در برابر اشعه

safety and Protection

دکتر فریدا عابسی

- متخصص رادیولوژی دهان ،فک و صورت
- دارای مدرک CES Dental Materialاز دانشگاه پاریس
- فلوشیپ لیزر از دانشگاه جنوآ ایتالیا

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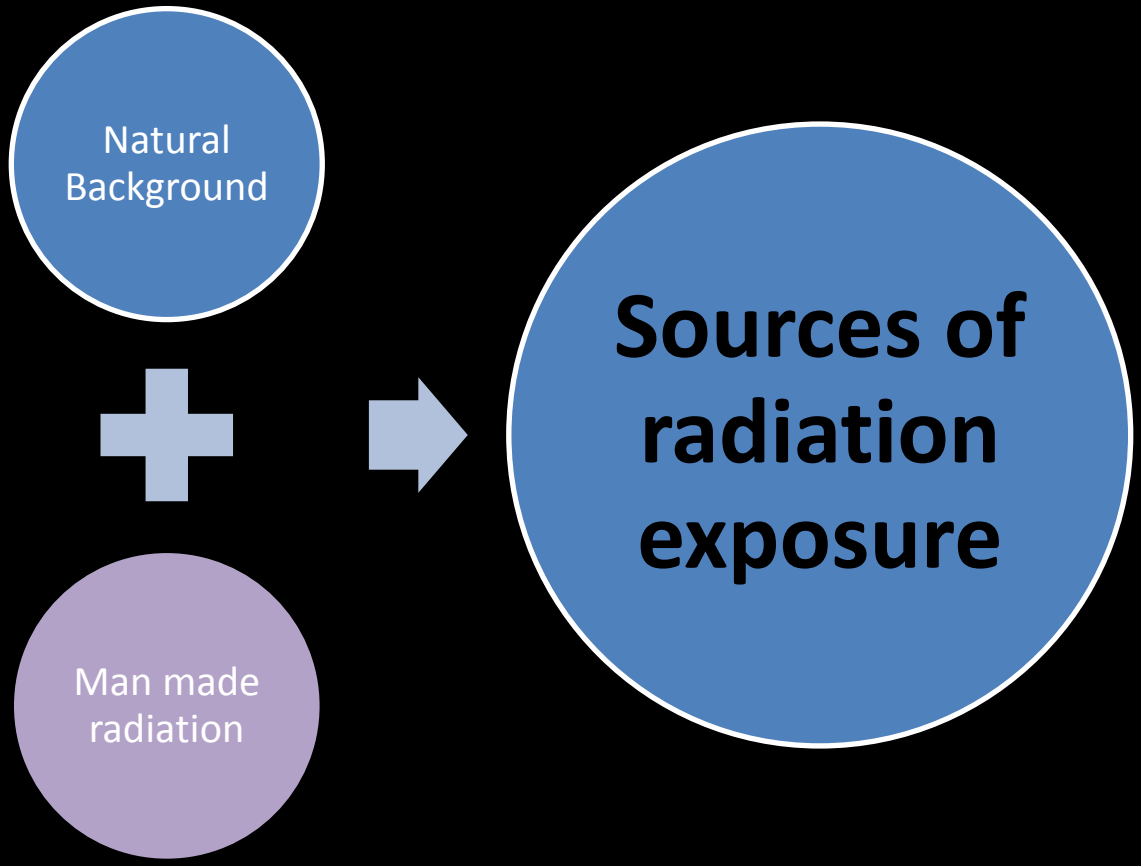
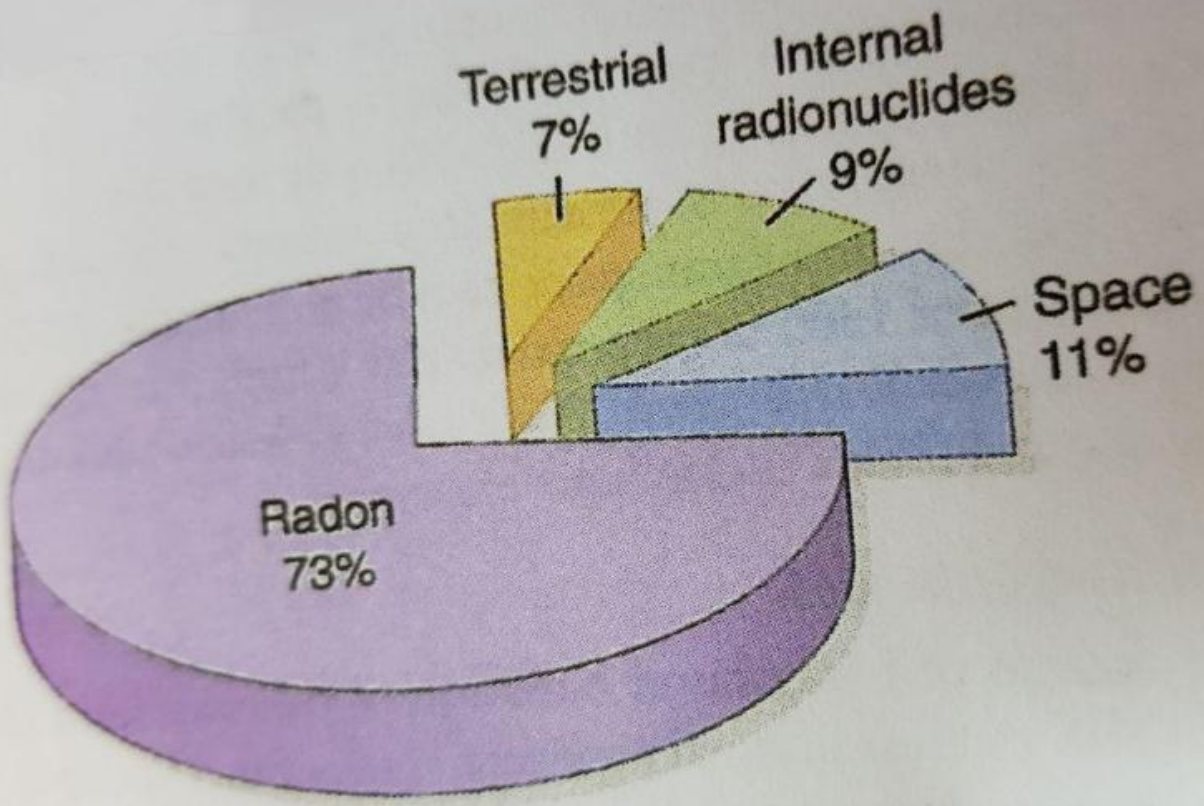
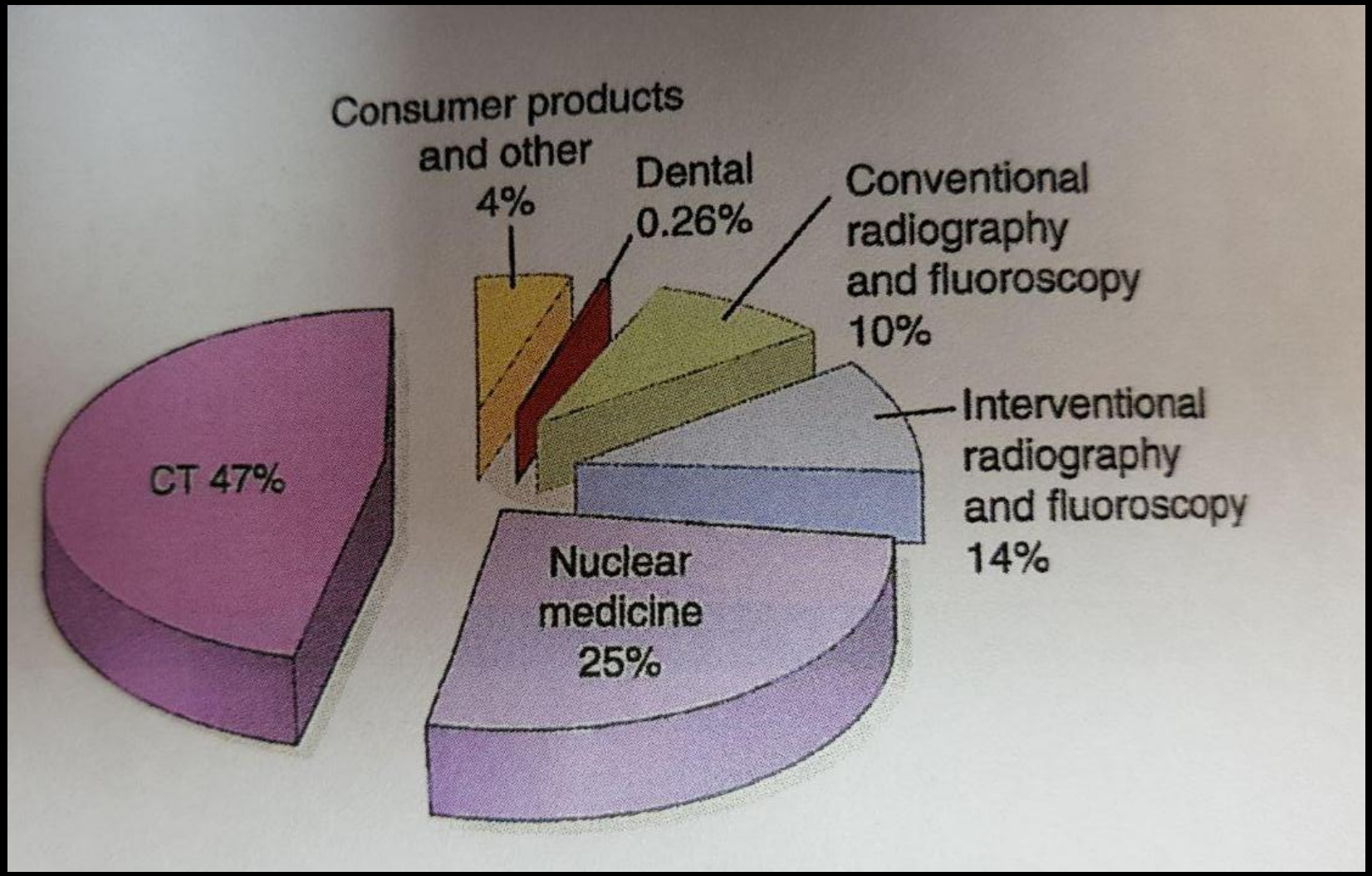

Natural Background
Man made radiation
Sources of radiation exposure

TABLE 3.1 Average Annual Effective Dose of Ionizing Radiation

Source	DOSE (mSv) US[a]	DOSE (mSv) Global[b]
Natural background		
Radon	2.3	1.3
Space	0.3	0.4
Internal radionuclides	0.3	0.3
Terrestrial	0.2	0.5
Subtotal background	***3.1***	***2.4***
Medical		
Computed tomography	1.5	0.57
Interventional fluoroscopy	0.4	
Conventional radiography and fluoroscopy	0.3	
Dental	0.007	0.002
Nuclear medicine	0.8	0.03
Subtotal medical	***3.0***	***0.6***
Consumer products and other	0.1	0.01
Grand total	***6.2***	***3.0***



Background
3.1 mSv/yr


Consumer products and other 4%
Dental 0.26%
Conventional radiography and fluoroscopy 10%
Interventional radiography and fluoroscopy 14%
Nuclear medicine 25%
CT 47%

Dentomaxillofacial radiology:risk and doses

- Optimised to produce a diagnostically acceptable image
- Less than the threshold needed to cause any deterministic effects
- Minimized to keep the risk of stochastic effects within an acceptable range

Estimating cancer risk from diagnostic dentomaxillofacial radiology

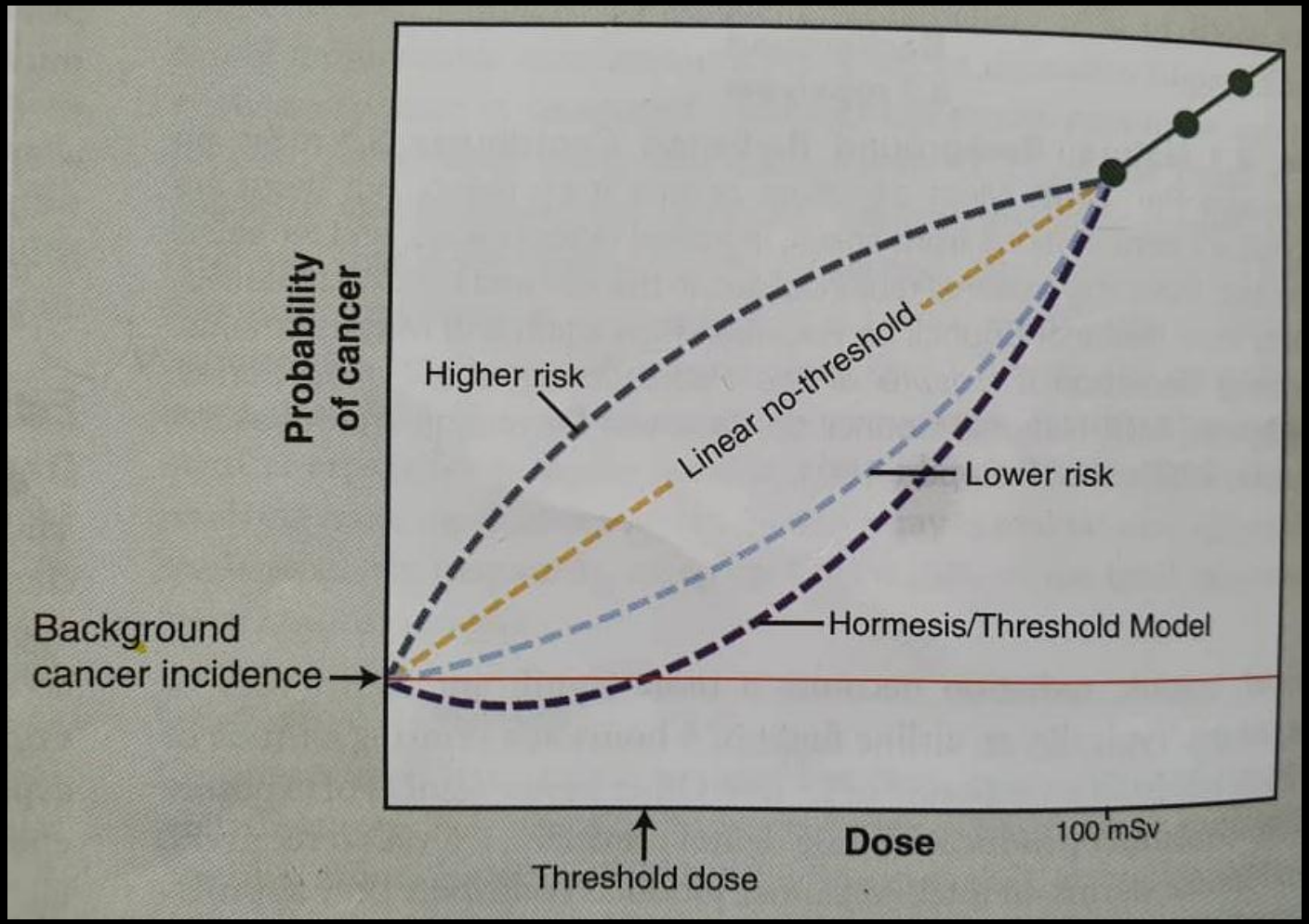
- Primary risk from dental x-ray:radiation – induced cancer
- IT is difficult it for low dose x-radiation

Because

Extrapolating, indistinguishable from other cancers,cancer is a common disease : direct measurement ,time between radiation exposure and development cancer :years

LNT(linear nonthreshold)hypothesis

- There is a linear relationship between dose and the risk of inducing a new cancer
- There is no threshold or safe dose below which there is no added risk.


Probability of cancer
Higher risk
Linear no-threshold
Lower risk
Hormesis/Threshold Model
Background cancer incidence
Dose
100 mSv
Threshold dose

patient doses from diagnosis dentomaxillofacial radiology

TABLE 3.2 Typical Effective Dose From Radiographic Examinations

Examination	Median Effective Dose	Equivalent Background Exposure[a]
Intraoral[b]		
Rectangular collimation		
Posterior bite-wings: PSP or F-speed film	5 µSv	0.6 day
Full-mouth: PSP or F-speed film	40 µSv	5 days
Full-mouth: CCD sensor (estimated)	20 µSv	2.5 days
Round collimation		
Full-mouth: D-speed film	400 µSv	48 days
Full-mouth: PSP or F-speed film	200 µSv	24 days
Full-mouth: CCD sensor (estimated)	100 µSv	12 days
Extraoral		
Panoramic[b]	20 µSv	2.5 days
Cephalometric[b]	5 µSv	0.6 day
Chest[c]	100 µSv	12 days
Cone beam CT[b]		
Small field of view (<6 cm)	50 µSv	6 days
Medium field of view (dentoalveolar, full arch)	100 µSv	12 days
Large field of view (craniofacial)	120 µSv	15 days
Multidetector CT		
Maxillofacial[b]	650 µSv	2 months
Head[c]	2 mSv	8 months
Chest[c]	7 mSv	2 years
Abdomen and pelvis, with and without contrast[c]	20 mSv	7 years

TABLE 3.3 Relative Radiation Level Designations, American College of Radiology

Relative Radiation Level	Adult Effective Dose Range	Pediatric Effective Dose Range
☢	<100 μSv	<30 μSv
☢☢	100 μSv to 1 mSv	30 μSv to 300 μSv
☢☢☢	1–10 mSv	300 μSv–3 mSv
☢☢☢☢	10–30 mSv	3–10 mSv
☢☢☢☢☢	30–100 mSv	10–30 mSv

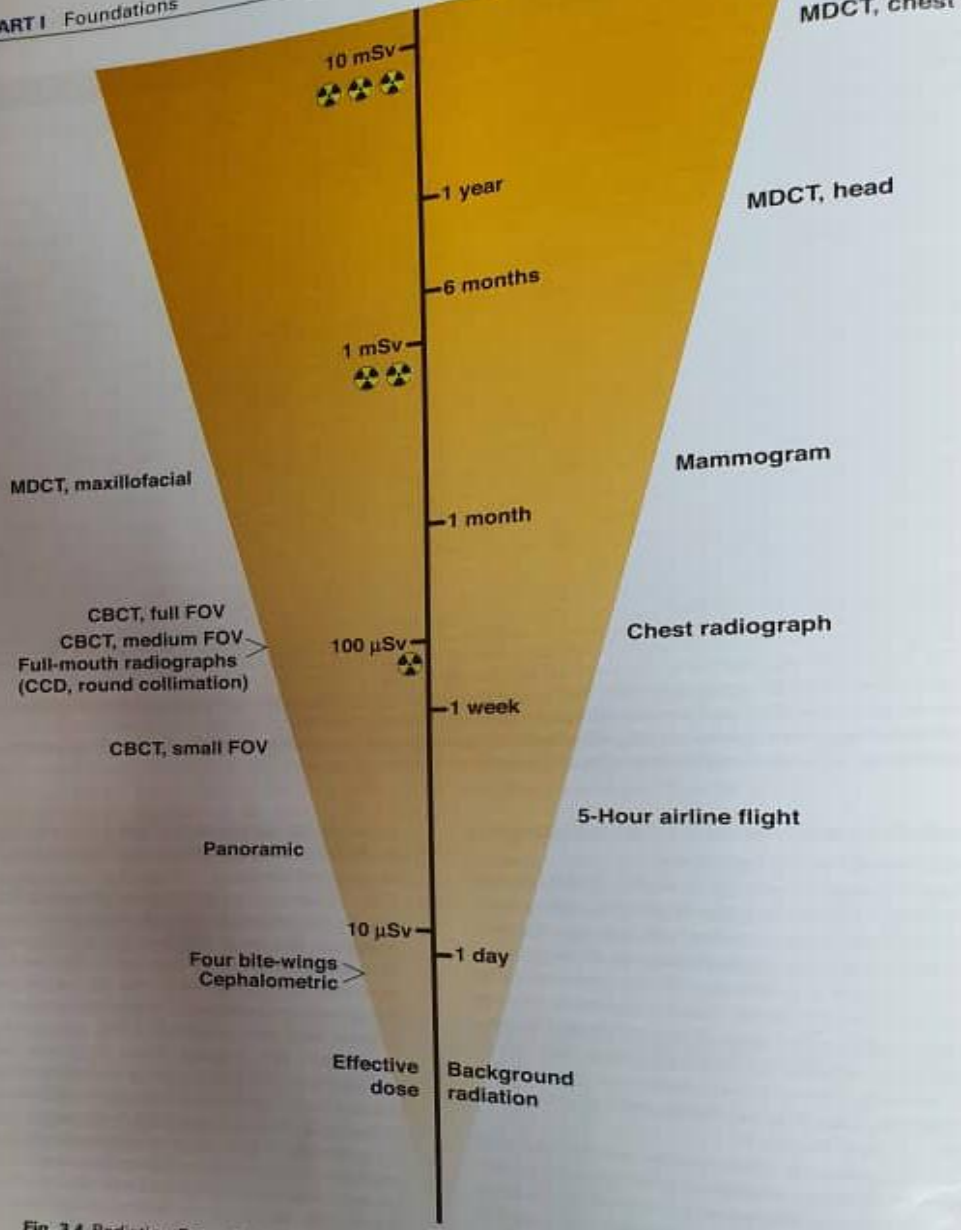


Fig. 3.4 Radiation Dose

Communication radiation risks to patients

Implementing radiation protection

- Justification
- Optimization
- Dose limitation

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Patient protection

- Patient selection criteria
- Conducting the examination

Reducing Dental Exposure

- The most effective approach to reduce unnecessary exposure is to reduce unnecessary radiographic examinations.

Conducting the examination

- Film and digital imaging
- Intensifying screens and film or digital imaging
- Source to skin distance
- Rectangular collimation
- Leaded aprons and collars
- Film and sensor holders

Kilovoltage , Mas, film processing, interpreting the images

BOX 3.1 Means for Reducing X-Ray Exposure

Use Good Clinical Judgment and Apply Evidence-Based Imaging Guidelines

- Make radiographs when they are likely to contribute to diagnosis and treatment planning
- Use selection criteria to assist in determining type and frequency of radiographic examinations

Use Best Practices in Radiographic Imaging

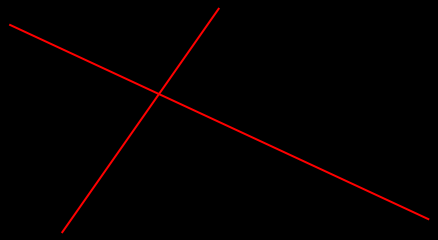
- Optimize your exposure settings to the patient's size and anatomic area to be imaged
- Intraoral radiography
  - Use E/F-speed film or digital sensors
  - Use holders to support film or digital sensors
  - Use rectangular collimation
  - Make exposures with 60–70 kVp
  - Use thyroid collars
- Panoramic radiography
  - Use rare-earth screens for film imaging or use digital systems
- Cephalometric radiography
  - Use rare-earth screens for film imaging or use digital systems
  - Use a thyroid collar, if it will not obstruct anatomic landmarks for cephalometry
- Cone beam computed tomography (CBCT)
  - Restrict the field of view to cover the region of interest
- Film-based imaging
  - Use time-temperature processing rather than "sight" processing, or use an automatic processor

Use Best Practices in Personnel Protection

- Stand behind a protective barrier or at least 6 feet (2 m) away from patient and away from the x-ray machine when making exposure
- For handheld devices, ensure the protective backscatter shield is in place

Film and digital imaging

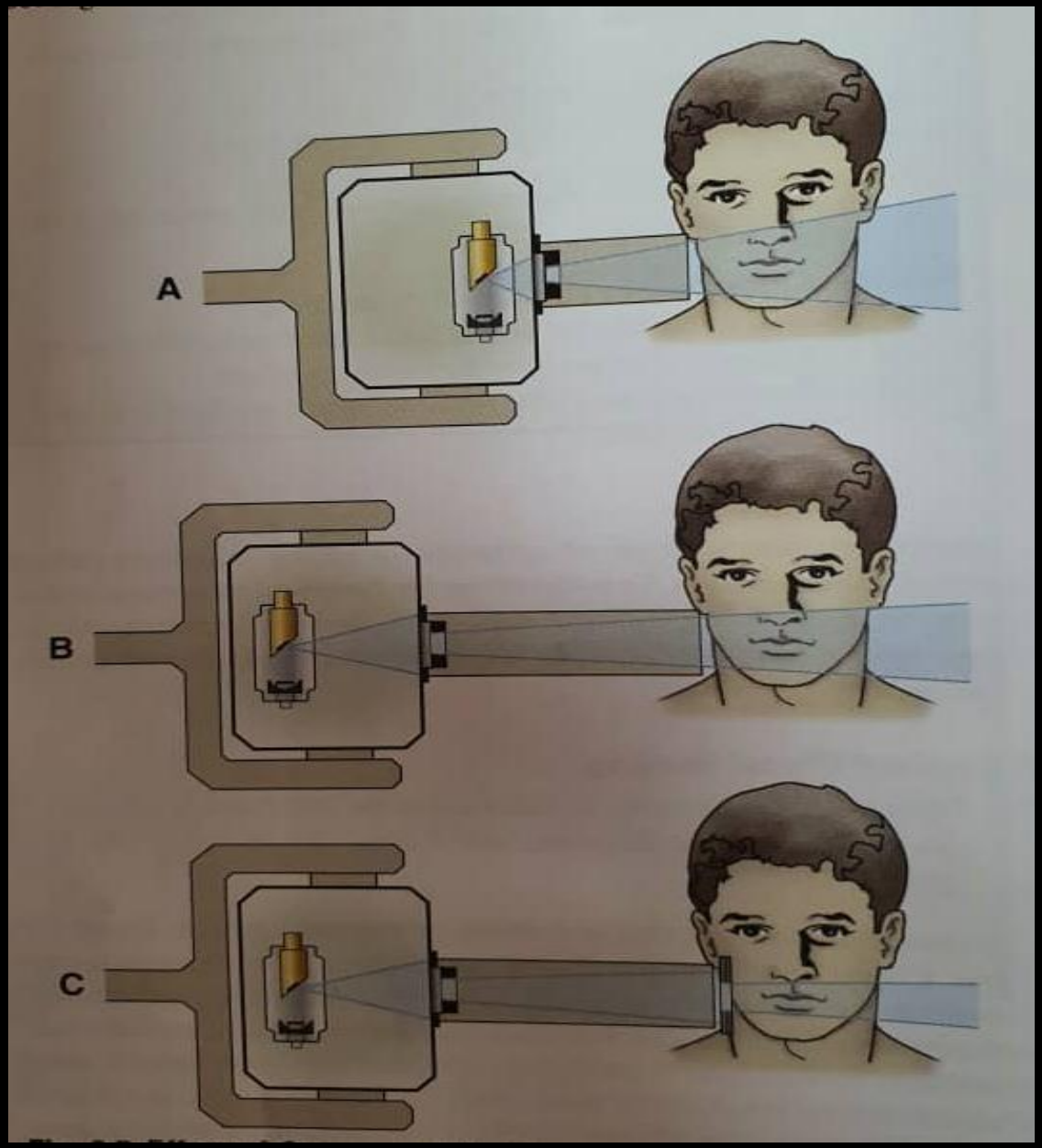
- F-speed or digital



- Rare –earth intensifying screens are recommended with high speed film of 400 or greater.
- Digital system =film in extraoral radiography

Source –to-skin distance

- Long distance (40 cm) : ↓ exposure 10-25 %
- Long SOD: less divergent , ↓ exposure tissue volume


A
B
C

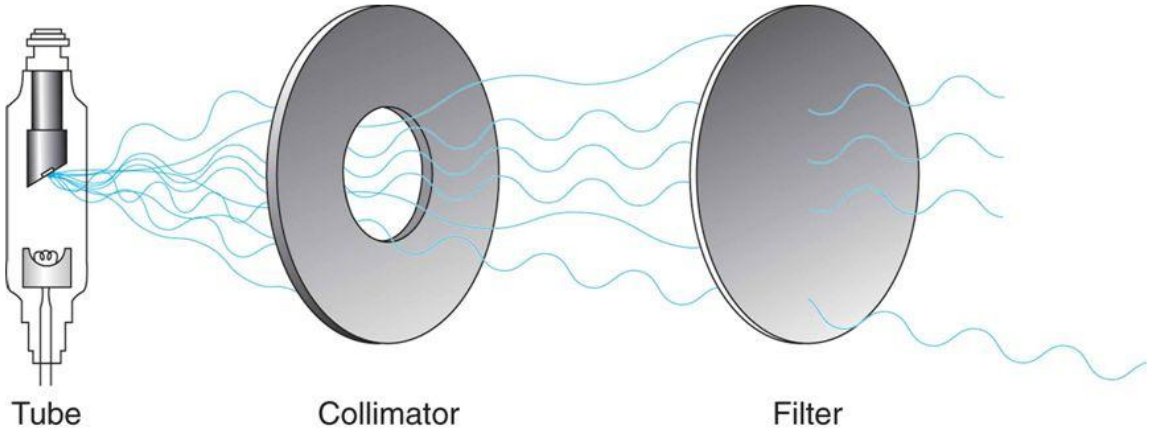


Figure 6-1 Collimator and filter. The collimator is a lead washer that restricts the size of the x-ray beam. The filter is an aluminum disc that filters (removes) the long wavelength x-rays.

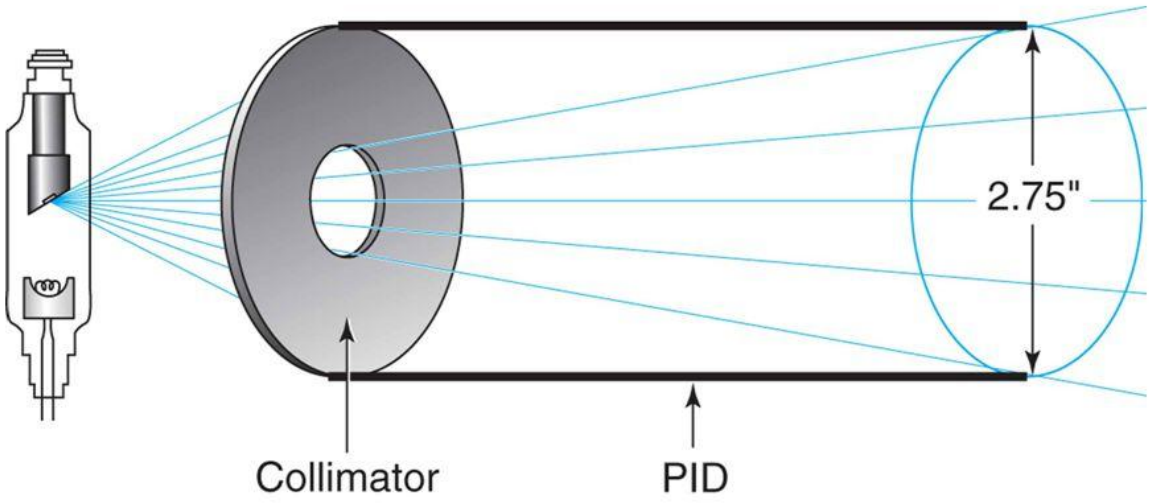
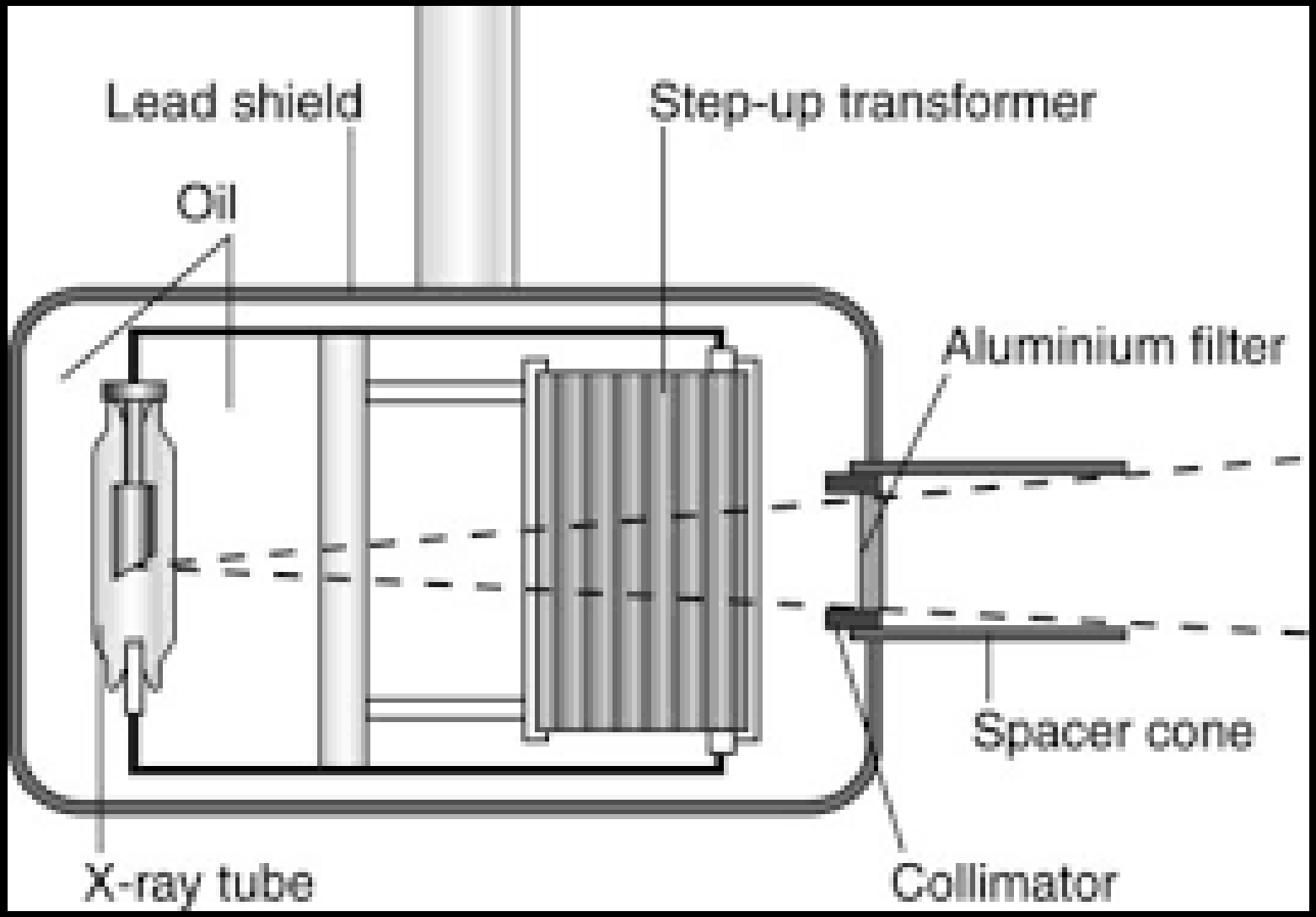
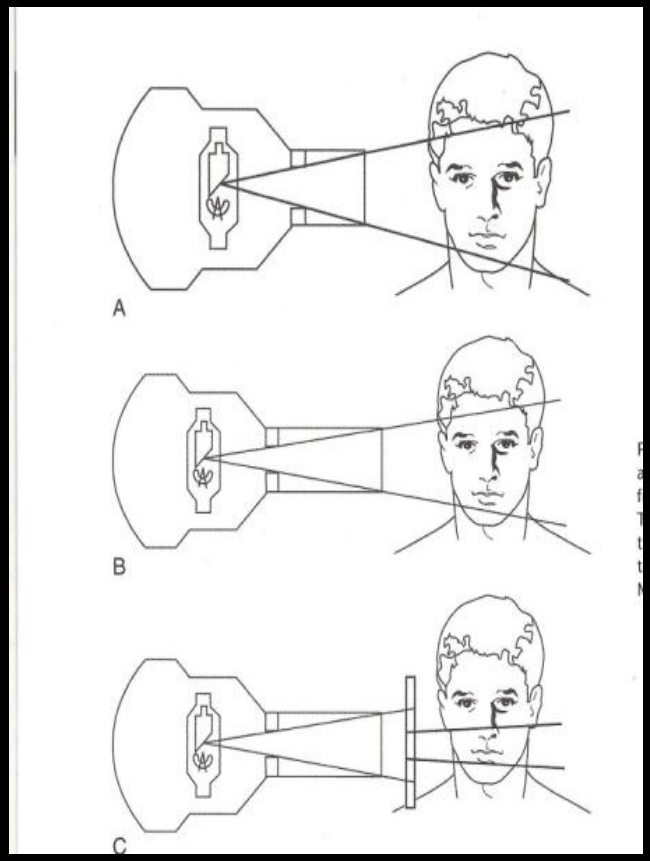


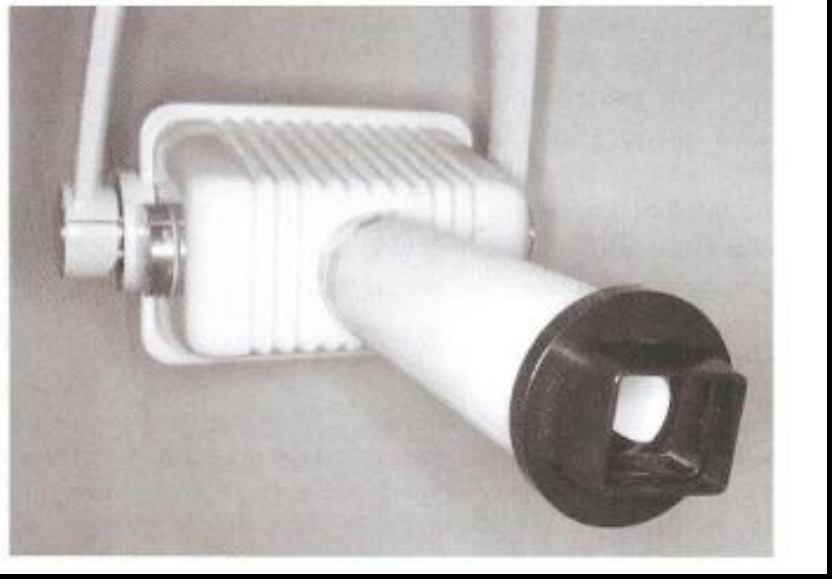
Figure 6-5 The collimator restricts the size of the primary beam to 2.75 in. (7 cm) at the end of the PID.

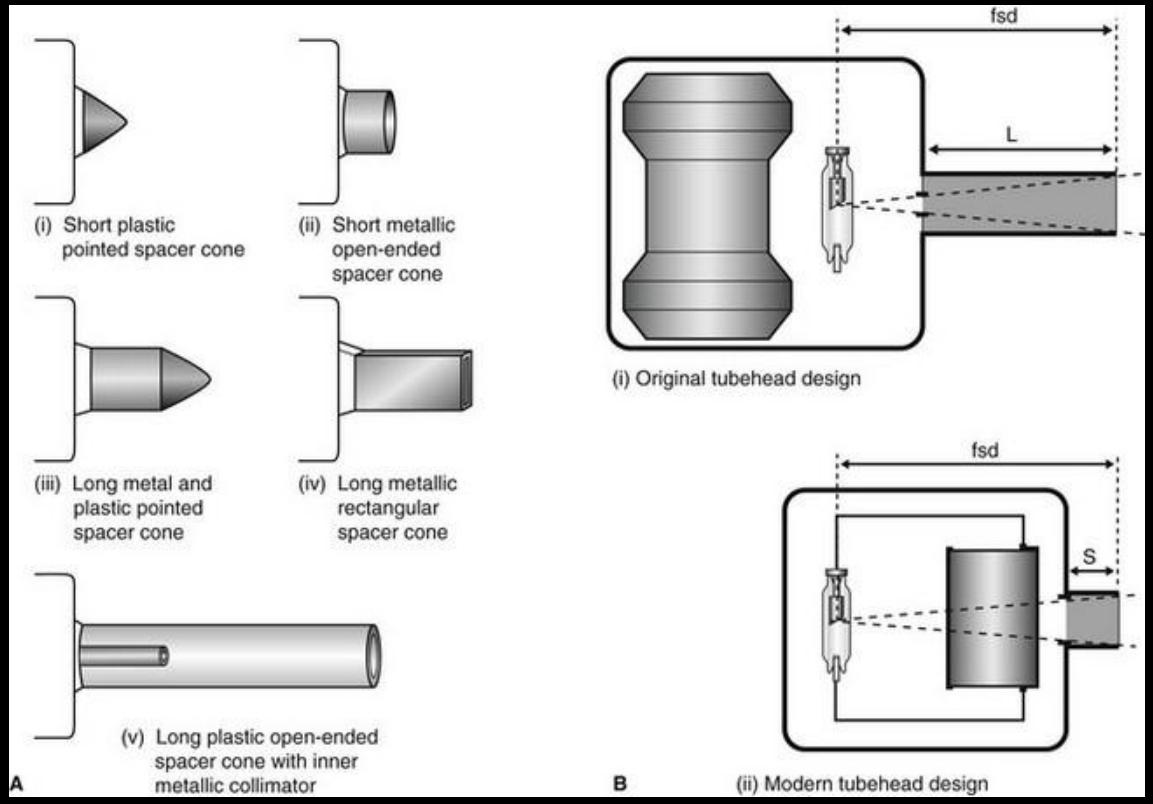

Lead shield
Step-up transformer
Oil
Aluminium filter
Spacer cone
X-ray tube
Collimator

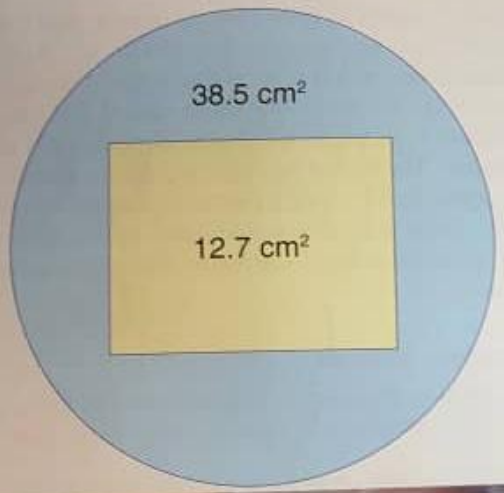
Rectangular Collimation

- Rectangular ↓ dose 5 round collimation
- ↓ 60 %






(i) Short plastic pointed spacer cone
(ii) Short metallic open-ended spacer cone
(iii) Long metal and plastic pointed spacer cone
(iv) Long metallic rectangular spacer cone
(v) Long plastic open-ended spacer cone with inner metallic collimator
A
fsd
L
(i) Original tubehead design
fsd
S
B
(ii) Modern tubehead design



A

B

C

D

(A) Graphical representation of the surface areas of round collimation

Filtration

- Low energy x-ray ↓ 20 %
- 50-70 kvp:1.5 mm AL
- 70:2.5 mm AL

Leaded Aprons and Thyroid Collars

- If all of the NCRP are followed ,the use of a leaded apron is not required

- Thyroid shielding strongly recommended for children
- Lead-free a:high A,low density :antimony,tin,tungsten

Film and sensor holders

- Significant reduction : in unacceptable images
- PID:The lead-lined cone or cylinder that directs the x-ray beam during a radiographic exposure.

KVP

- KVP ↓ greater contrast,enhance diagnosis
- Kvp ↑ lower contrast,decrease dose
- Best balance :60-70

mAs

- Tube voltage, milliamperage, exposure time

- Image density is controlled by mAS
- Radiograph with correct density :very faint soft tissue outlines,gray scale that adequately distinguishes enamel,dentin,cortical bone and trabecular bone.

Film Processing

- Time –temperature
- Should follow the film manufacturer ‘s recommendation for processing solutions
- Automatic film processors :30 % repeated radiography :processor variability

Interpreting the images

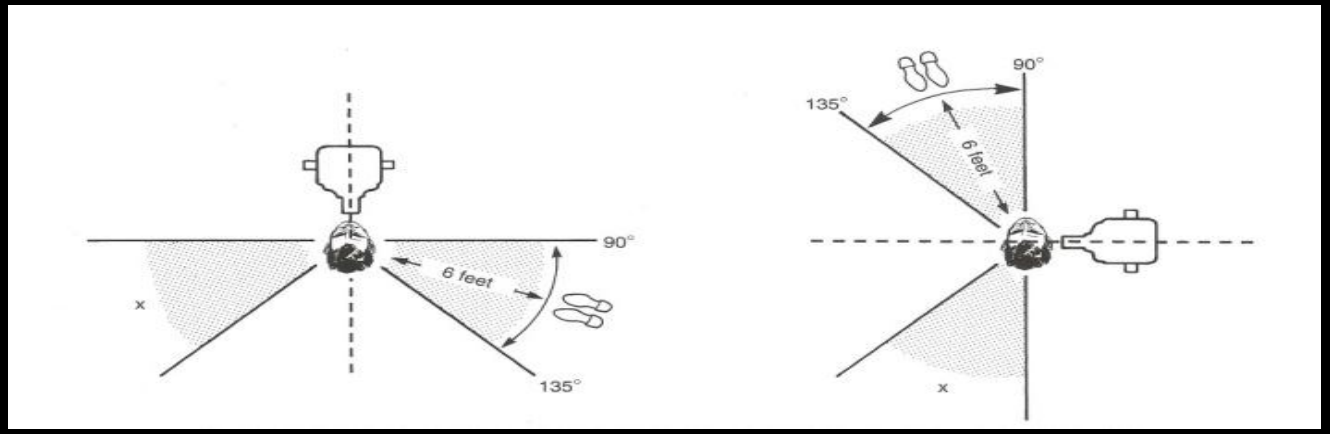
- Radiographs :semidarkened room ,magnifying glass

- Digital images :computer screen,darkened environment

Personnel protection

- Operators of radiographic equipement should use barrier protection when possible
- 1.Barrier protection : 2 mm pb,(1mGy per year) Sinon position and distance rule
- Operator stand 6 feet(2 m),90-135
- Never hold films or sensors in place
- Neither operator no patient should hold tube housing during exposure
- Personnel monitoring

position and distance rule



Perssonel Monitoring devices

ADA recomends :workers :annual dose >1msv

Personal dosimeter:occupational dose

film badge:100 micro Gy

- Thermoluminescence dosimeter:50 micro Gy
- Optically stimulated luminescence :10 microGy
- Direct ion storage ,USB:internet


13.54 mGy
1.325 mGy/s
10.22 s
131.4 µGy
10.0 Hz
103
35.46 ms
23.3 °C

Dose Limits

- DLs imply that if received annually ,the risk of death would be less than 1 in 10000
- These limits pertain to planned exposure situations (no background ,no therapeutic)

TABLE 3.4 Recommended Dose Limits for Human Exposure to Ionizing Radiation

	NCRP[a]	ICRP[b]
Occupational Exposure		
Annual effective dose	50 mSv/year	20 mSv, averaged over defined 5-year periods
Cumulative effective dose	10 mSv × age	100 mSv in 5 years *and* should not exceed 50 mSv[c] in any single year
Annual equivalent dose		
Lens of eye	Absorbed dose of 50 mGy	20 mSv, averaged over defined 5-year periods, *and* exposure in any single year should not exceed 50 mSv
Skin	500 mSv	500 mSv
Hands and feet		
Pregnant workers	0.5 mSv/month to embryo-fetus	1 mSv to the embryo/fetus after declaration of pregnancy
Public Exposure[d]		
Annual effective dose	1 mSv (continuous or frequent exposure) 5 mSv (infrequent exposure)	1 mSv
Annual equivalent dose in:		
Lens of eye	15 mSv	15 mSv
Skin	50 mSv	50 mSv

Quality assurance

Protocols for x-ray tube,image receptor,……

Periodic assessment of the performance of all parts of the radiologic procedure.

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با تشکر از همراهی شما