Problems & Questions

Where is the maxillary sinus?

http://netanatomy.com/
Anatomy question: given transverse section, with different options: R Atrium, L Atrium, R Ventricle, L Ventricle, and Esophagus. Where is the R Ventricle?
Dose at a depth, $d$

Given table of TMR values and the dose to the tumor 150 cGy at depth = 10 cm. What is the dose at depth $d = 5$ cm. (10x10 FS)

Dose at d_{max}

Given PDD table, and the dose to the tumor. What is the dose at d_{max}?
Example: What is the dose at d_{max} when 200 cGy is prescribed to a depth of 10 cm for an 18 MV beam? For a 6 MV beam?

Corrected Rdg for Temp & Press

Given the reading of an ion chamber, the temperature and the pressure. What is the corrected reading?
Reading from chamber is 103 nC.
Temperature is 20.5 deg C
Pressure is 745 mm Hg
What is the corrected reading?
4

What is GTV?

1. Gross Tumor Volume

It is the tumor volume (GTV) in the gross measurable part of the tumor. It may consist of primary tumor, extracapsular tumor, lymph nodes, and other extracapsular structures. GTV is generally considered to be the target volume of the radiation treatment.

2. Clinical Target Volume

The clinical target volume (CTV) consists of the GTV and any other tissues with increased risk of being involved. GTV can be defined as the tumor volume that shows up on imaging. CTV must be defined on the basis of clinical information and treatment planning.

3. Internal Target Volume

The internal target volume (ITV) consists of CTV and any structures that may move due to body motion. It is defined as the volume that includes the GTV and the structures that are at risk for motion. ITV is used for planning and treatment planning.

4. Planning Target Volume

The planning target volume (PTV) includes CTV and any additional margins to account for setup uncertainties and organ motion. PTV is used for treatment planning and is the volume that the radiation beams are directed at.

5. Planning Organ at Risk Volume

The planning organ at risk volume (POAR) includes any organs at risk for radiation treatment. POAR is defined as the volume that includes the GTV and any structures that may be at risk for radiation treatment. POAR is used for planning and treatment planning.

After changing the bending magnet in the linear accelerator, what factors could be changed?

Options: flattering filter, ……

- Change beam energy
- Affect flatness and symmetry
Question about penumbra. Physical penumbra, Geometrical penumbra.

- The term penumbra, in a general sense, means the region, at the edge of a radiation beam, over which the dose rate changes rapidly as a function of distance from the beam axis.
- Geometric penumbra the penumbra width increases with increase in source diameter, SSD, and depth but decreases with an increase in SDD (see example S/P).
- Dosimetrically, the term physical penumbra width has been defined as the lateral distance between two specified isodose curves at a specified depth.

Penumbra is measured between which 2 percent lines at dmax?

Geometric Penumbra example

For a Cobalt unit with a source of 2 cm diameter, with the diaphragm distance at 45 cm, the geometrical penumbral on the skin for a treatment at 100cm SSD is?

a) 1.1cm  c) 2.0cm
b) 1.6cm  d) 2.4cm
Penumbra Example

The size of the Co-60 radiation source is 1cm. The film on the patient table is located at the distance of 100 cm from the radiation source. The collimator is located at the distance of 40 cm from the radiation source. What is the penumbra length on the film?

a) 1.0 cm
b) 1.5 cm
c) 2.0 cm
d) 2.5 cm

What is the difference between Magnetron and Klystron?

- The magnetron is a device that produces microwaves.
- The klystron is not a generator of microwaves but rather a microwave amplifier. It needs to be driven by a low-power microwave oscillator.
- Magnetrons operate at 2 MW peak power output to power low-energy linacs (6 MV or less).
- Higher-energy linacs use klystrons
- Power for e-gun and accelerating guide

What data is needed to calculate the dose by hand calc?

- Fractional Dose (cGy)
- Output of the machine (1 cGy per MU)
  - (in what setup?)
- Sc(Field size)
- Sp (bikd FS)
- ISF = (SCD/STD)^2
- WF
- TF
- OAF
- Attenuation
  - SSD use PDD (FS, d, SSD)
  - SAD use TMR (FS, d)
Scattered photon energy; what is the maximum energy and at what angle?

If the energy of the incident photon is high, we have the following important generalizations:
(a) the radiation scattered at right angles is independent of incident energy and has a maximum value of 0.511 MeV;
(b) the radiation scattered backwards is independent of incident energy and has a maximum value of 0.255 MeV.

Compton Interactions

• Interaction of a low-energy photon. If the incident photon energy is much less than the rest energy of the electron, only a small part of its energy is imparted to the electron, resulting in a scattered photon of almost the same energy as the incident photon.
• Interaction of a high energy photon. If the incident photon has a very high energy (much greater than the rest energy of the electron), the photon loses most of its energy to the Compton electron and the scattered photon has much less energy.

Compton interactions

• Scattered photons produced by high-energy photons carry away only a small fraction of the initial energy.
• Thus, at high photon energy, the Compton effect causes a large amount of energy absorption compared with the Compton interactions involving low-energy photons.
MU Chambers?

What is the purpose of the ion chamber that is located at the head of the linear accelerator?
Dose, Dose Rate, Symmetry (radial and transverse)

For 2 opposed parallel beams, what factors affect \( \frac{dm}{dp} \) (options: energy, patient thickness, ……)

\[ \text{FIG. 11.13: Depth dose curves for parallel opposed field normalized to endpoint value. Patient thickness = 25 cm, Field size = 15 x 15 cm, 300 x 300 cm.} \]

For 2 opposed parallel beams, what factors affect \( \frac{dm}{dp} \) (options: energy, patient thickness, ……)

\[ \text{FIG. 11.12: Ratio of maximum penumbra to endpoint dose plotted as a function of patient thickness for different beam qualities. Parallel opposed fields, field size = 15 x 15 cm, 30 x 30 cm.} \]
Conversion

Given the value of 50 R, is it equal to:

- 50 Bq
- 50 rad
- 50 Gy
- 50 Kerma

What is $f_{air}$? $f_{med}$?

---

Question on the reason of unclear image produced by MV modality.

- High energy
- Dominated by Compton scatter
- How do we compensate with Portal films? With EPIDs?

---

SRS vs SRT?

- Stereotactic Radiosurgery
  - Single fxn
  - Dose relatively low compared to large fraction regimes (16-24 Gy)
- Stereotactic Radiotherapy
  - Few fractions
  - Higher dose than SRS
  - 3 fxns, 16-20 Gy per fxn
**DVH**

- Question on the DVH graph, what is the vertical axis, the horizontal axis.
- Is it useful to determine dose distribution?
- Different graphs are given and the question is to point to the DVH graph.

**H&D curve**

- Different graphs are given and the question is to point to the H&D graph.
- What is it?
What is the difference between x-rays and gamma rays?

- Based on origination

What is the difference between Bremmstrahlung & Characteristic x-ray?

What are the advantages of the pocket dosimeter?
What is the reason of the tail on the electron beam PDD graph?

Geometric Separation

- Gap calculation
  \[ S_i = \frac{1}{2}L_i \left( \frac{d}{SSD_i} \right) \]
  \[ S_2 = \frac{1}{2}L_2 \left( \frac{d}{SSD_2} \right) \]
- Geometric boundary defined by 50% decrement line
- gap = \( S_1 + S_2 \)

Skin Gap Calc

Assume you wish to match the geometric edge of two 20 cm x 20 cm, 4 MV, 80 cm SSD treatment fields at 10 cm tumor depth. The correct gap on the skin would be?
a) 1.0 cm
b) 1.25 cm
c) 2.0 cm
d) 2.5 cm
e) 3.0 cm
Magnification

A cross-table lateral radiograph is taken to determine the spinal cord depth. A 5 cm diameter ring placed on the patient's skin posterior to the cord measures 6.75 cm on the radiograph, if the cord depth below the skin measures 7.4 cm, what is the cord depth within the patient?

a) 5.0 cm  
b) 5.5 cm  
c) 6.0 cm  
d) 9.0 cm

Magnification

A film taken on the simulator has a source to film distance of 160 cm. The technologist forgets to note the field size at the treatment distance of 80 cm. The field measures 10 cm x 20 cm on the film. The field size at 80 cm is:

a) 8 cm x 16 cm  
b) 12.5 cm x 25 cm  
c) 10 cm x 20 cm  
d) 5 cm x 10 cm  
e) 20 cm x 40 cm

Effective Depth

In the diagram below, a patient is treated with a single posterior oblique field. The prescription dose is 200 cGy to the isocenter (without lung correction). Calculate the dose delivered if lung corrections were taken into account.

10x10 field  
TAR1 = 0.78  
TAR3 = 0.54  
Density of tissue = 1  
Density of lung tissue = 0.25
Inverse Square Law
The output of a 6 MV accelerator is measured at dmax using an SSD of 104 cm rather than 100 cm SSD. What is the percentage error?

a) 7.44 %

b) 7.0 %

c) 8.0 %

d) 8.5 %

Field size?
Parallel opposed fields are setup on a 4 MV linear accelerator at 80 cm SAD. The patient’s anterior-posterior diameter is 24 cm. The field size at midline is 15 cm x 15 cm. The field size on the skin surface is ____?

a) 10.8 cm

b) 12.8 cm

c) 13.8 cm

d) 15.0 cm

e) 17.6 cm

New Dose Rate
The dose rate for a 10 x 10 cm Cobalt-60 field is 100 cGy/min measured in air, at 80 cm SAD. The BSF is 1.035. The dose rate in tissue at depth = dmax, 80 SSD is:

a) 108.5 cGy/min

b) 102.2 cGy/min

c) 100.0 cGy/min

d) 98.8 cGy/min

e) 96.6 cGy/min
Effective Path Length

What is the effective path length through 3 cm of tissue, 10 cm of an inhomogeneity of 0.25 density, and 3 cm more of tissue?

a) 7.5 cm  
b) 8.5 cm  
c) 13 cm  
d) 6 cm  
e) none of the above

Treatment Time

The dose rate in air for a 15 cm x 15 cm field at 80 cm is 120 cGy/min for an iso-centric Cobalt-60 treatment. The TAR for a 15 cm x 15 cm field at 12 cm depth is 0.686. A small corner block is used and the tray factor is 0.96. The time needed to deliver 90 cGy is ______ ?

a) 0.54  
b) 1.05  
c) 1.09  
d) 1.14

MU calc

A 6 MV accelerator is calibrated for 1 cGy = 1 mu at 101.5 cm in water at a 10 cm x 10 cm field size. A 100 SAD parallel opposed treatment is planned for the lung to 10 cm depth using a 12 cm x 12 cm open field.

Output factor = 1.02. 
TMR = 0.782. 
Tray factor = 0.97.

Calculate the mu settings required to deliver 90 cGy.

a) 110  
b) 113  
c) 115  
d) 119
Field Size?

The collimator setting to treat a 40 cm field at 130 cm SSD on an 80 cm SAD Cobalt unit is ____ cm.

a) 15.1 cm  c) 40.0 cm  
b) 24.6 cm  d) 50.4 cm

Given the wedge angle, what is the hinge angle?

- Wedge angle  Hinge angle
  \[ \theta = 90^\circ - \phi / 2 \]

There are certain combinations of hinge angle and wedge angle that will produce a relatively uniform dose distribution. Circle on the list below the combinations which are correct i.e. that will give a relatively uniform dose distribution.

- Hinge Angle       Wedge Angle  
  a) 90° 45°  
  b) 120° 30°  
  c) 60° 60°  
  d) 60° 45°  
  e) 90° 60°
**Wedge Angle**

When treating a patient with 2 oblique ports, 120° apart, the optimum wedge angle is:

a) 15°  

b) 30°

c) 45°

d) 60°

---

**Mayneord’s F Factor**

Question to calculate PDD at extended PDD @ 6 Mv.

- The Mayneord F factor method works reasonably well for small fields since the scattering is minimal under these conditions.
- However, the method can give rise to significant errors under extreme conditions such as lower energy, large field, large depth, and large SSD change.

---

**Mayneord’s F-factor**

The percentage depth dose for a 10 cm x 10 cm Cobalt field, 80 cm SSD, at 5 cm depth, is 78.5%. The appropriate percentage depth dose at 100 cm SSD for this same beam is probably ______?  

a) 79.2 %

b) 75.0 %

c) 80.2 %

d) 83.0 %

e) 85.2 %
### What is the energy used for treating with protons?

- 150 to 250 MeV

---

### What are the diseases that requires to treat the craniospinal?

- medulloblastoma

---

### Photon beam algorithms

**Question on the PHOTON treatment planning ways:**

- **Options:** convolution, or pencil beam, monte carlo
HVL

- There were different questions to calculate HVL.
- There was a question to calculate TVL.
- Given the TVL, and the output intensity, what is the input intensity?
- A Question with the relation between HVL and TVL.

Best method of measuring Cobalt-60 head leakage

Probability of Photoelectric effect

Calculate the ratio of the photoelectric attenuation for 80 keV photon in a material with z=50 and a 40 keV photon in a material with z=20.
Explain a 3:2 weighting AP:PA using 180 cGy per fraction.

Question on DICOM. Is it suitable to store treatment planning?
Digital Imaging and Communications in Medicine