X-RAY TUBE AND HEAT DISPERSING

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Fundamental of Radio Physics

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Outline

- Limitation of x-ray tube
- Line focus
- Rotational anode tube
- Heat rating

Objectives

The student should be able to do the followings;

* Explain the limitation of x-ray tube
* Mention the effect of line focus
* Explain the advantages of rotational anode tube
* Describe the heat rating

Limitation of X-Ray Tube

1- Heat generated during operation, which can damage the tube
2- The inefficiency of energy conversion (less than 1% of the input energy is converted to x-rays)
3- Limited control over independent operation of parameters like kVp and mAs (in older gas-filled tubes)
4- Practical limits on filament current which can affect the maximum mAs.
5- Radiation hazard

Limitation of X-Ray Imaging

X-ray imaging has several limitations:

1- difficulty capturing soft tissues

2- limited detail for complex fractures

3- exposure to ionizing radiation.

Question:

Why can’t x-rays detect soft tissue injuries?

Answer:

Because these tissues don’t absorb x-rays the same way bones do, many injuries remain undetected on standard X-ray scans.

Line Focus

The advantage is

- simultaneously improves spatial resolution and heat capacity.

The disadvantage is

* the radiation intensity on the cathode side of the x-ray field is greater than that on the anode side.

Electrons interact with target atoms at various depths into the target. So the anode-heel effect may limit the field sizes that can be used

Rotational anode tube

The advantages are of rotational anode:

1- disperse the heat generated when a beam of electrons strikes it, allowing for higher power and shorter exposure times than stationary anode tubes.

2- This design significantly improves performance.

Heat Rating

It's the thermal capacity and limits, which are crucial for preventing damage during operation.

The rating **depends on factors**

1- focal spot size

2- anode material

3- cooling systems

The heat units can be calculated from the following equations

$$Number\ of\ heat\ units(one\ phase)\ (HU) = (Tube\ voltage)(Tube\ current)(Time)$$
$$= (kVp)(\mathrm{mA})(\mathrm{sec})$$

$$Number\ of\ heat\ units\ (three\ phases)\ (HU) = (Tube\ voltage)(Tube\ current)(Time)(1.35)$$
$$= (kVp)(mA)\ (\mathrm{sec})\ (1.35)$$

References

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- Hendee W., and Ritenour E.,. (2002). *Medical Imaging Physics*. Willy-Liss,Inc