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1 X-RAY TUBE

1.1 Introduction

The x-ray tube serves the function of creating x-ray photons from electric energy supplied by the x-ray generator. The process of creating the x-ray beam is very inefficient, with only (1 percent) of the electric energy converted to x-ray photons and the remaining (99 percent) converted to heat in the x-ray tube assembly. Thus, to produce sufficient x-ray output for diagnostic imaging, the x-ray tube must withstand and dissipate a substantial heat load, a requirement that affects the design and composition of the x-ray tube. The major x-ray tube components are the cathode and anode assemblies, the tube envelope, the rotor and stator (for rotating anode systems), and the tube housing. The design of the x-ray tube determines the basic characteristics of the x-ray beam such as focal spot size, x-ray field uniformity, and the x-ray energy spectrum. These x-ray beam characteristics are important because they affect radiologic parameters such as spatial resolution, image contrast, and patient dose.

1.2 X-ray Production

To summarize, x-rays are produced in a standard way: by heating a filament, which releases electrons by thermionic emission, accelerating electrons with a high voltage and allowing them to collide with the focal spot on the target/anode. X-rays are produced via two interactions in the anode.

1.3 Bremsstrahlung x-rays

Bremsstrahlung x-rays (German for "braking") - electrons lose kinetic energy as they pass through atoms in the anode because they are attracted to the positively charges nuclei. The closer to the nucleus the electron passes, the more kinetic energy it loses and it is deflected to continue moving in another direction at lower energy, or stopped altogether. This is where maximum kinetic energy is transferred to the production of an x-ray that is emitted from the anode.

1.4 Characteristic X-rays

If electrons possess an energy that is equivalent to, or greater than, the binding energy of the orbiting electrons in target atoms, these electrons are likely to be ejected from the atom. This most often occurs in the inner electron shell (K-shell). The ejected electron is known as a photoelectron. The vacancy left in the K-shell must be filled in order for the atom to remain stable (law of conservation of energy) so outer shell electrons drop down to fill the shell. This process of electron transfer between shells produces x-rays that are "characteristic" of the binding energies of that particular atom/material, hence the name.

2 MICRSCOPE

2.1 Introduction

A microscope is a laboratory instrument used to examine objects that are too small to be seen by the naked eye. Microscopy is the science of investigating small objects and structures using a microscope. Microscopic means being invisible to the eye unless aided by a microscope.

There are many types of microscopes, and they may be grouped in different ways. One way is to describe the method an instrument uses to interact with a sample and produce images, either by sending a beam of light or electrons through a sample in its optical path, by detecting photon emissions from a sample, or by scanning across and a short distance from the surface of a sample using a probe. The most common microscope (and the first to be invented) is the optical microscope, which uses lenses to refract visible light that passed through a thinly sectioned sample to produce an observable image. Other major types of microscopes are the fluorescence microscope, electron microscope (both the transmission electron microscope and the scanning electron microscope) and various types of scanning probe microscopes.

2.2 Importance of the Microscope in Life Science

Many life science discoveries would not have been possible without the microscope. For example:

1. Cells are the tiny building blocks of living things. They couldn't be discovered until the microscope was invented. The discovery of cells led to the cell theory. This is one of the most important theories in life science.

2. Bacteria are among the most numerous living things on the planet. They also cause many diseases. However, no one knew bacteria even existed until they could be seen with a microscope.

The invention of the microscope allowed scientists to see cells, bacteria, and many other structures that are too small to be seen with the unaided eye. It gave them a direct view into the unseen world of the extremely tiny. You can get a glimpse of that world.

2.3 Invention of the Microscope

The microscope was invented more than four centuries ago. In the late 1500s, two Dutch eyeglass makers, Zacharias Jansen and his father Hans, built the first microscope. They put several magnifying lenses in a tube. They discovered that using more than one lens magnified objects more than a single lens. Their simple microscope could make small objects appear nine times bigger than they really were.

2.4 Modern Microscopes

These early microscopes used lenses to refract light and create magnified images. This type of microscope is called a light microscope. Light microscopes continued to improve and are still used today. The microscope you might use in science class is a light microscope. The most powerful light microscopes now available can make objects look up to 2000 times their actual size.

3 CT SCANNER

3.1 Introduction

A CT scan or computed tomography scan (formerly known as computed axial tomography or CAT scan) is a medical imaging technique used in radiology to obtain detailed internal images of the body noninvasively for diagnostic purposes. The personnel that perform CT scans are called radiographers or radiology technologists.

CT scanners use a rotating X-ray tube and a row of detectors placed in the gantry to measure X-ray attenuations by different tissues inside the body. The multiple X-ray measurements taken from different angles are then processed on a computer using reconstruction algorithms to produce tomographic (cross-sectional) images (virtual "slices") of a body. The use of ionizing radiation sometimes restricts its use owing to its adverse effects. However, CT can be used in patients with metallic implants or pacemakers where MRI is contraindicated.

Since its development in the 1970s, CT has proven to be a versatile imaging technique. While CT is most prominently used in diagnostic medicine,it also may be used to form images of non-living objects. The 1979 Nobel Prize in Physiology or Medicine was awarded jointly to South AfricanAmerican physicist Allan M. Cormack and British electrical engineer Godfrey N. Hounsfield "for the development of computer-assisted tomography".

3.2 Medical Use

Since its introduction in the 1970s,CT has become an important tool in medical imaging to supplement X-rays and medical ultrasonography. It has more recently been used for preventive medicine or screening for disease, for example, CT colonography for people with a high risk of colon cancer, or full-motion heart scans for people with a high risk of heart disease. Several institutions offer full-body scans for the general population although this practice goes against the advice and official position of many professional organizations in the field primarily due to the radiation dose applied.

The use of CT scans has increased dramatically over the last two decades in many countries.[15] An estimated 72 million scans were performed in the United States in 2007 and more than 80 million in 2015.

3.3 Biomechanical Use

CT is used in biomechanics to quickly reveal the geometry, anatomy, density and elastic moduli of biological tissues.

4 DENTAL X-RAY

4.1 Introduction

Dental X-rays (radiographs) are images of your teeth that your dentist uses to evaluate your oral health. These X-rays are used with low levels of radiation to capture images of the interior of your teeth and gums. This can help your dentist to identify problems, like cavities, tooth decay, and impacted teeth. Dental X-rays may seem complex, but they're actually very common tools that are just as important as your teeth cleanings.

4.2 why dental X-rays are performed

Dental X-rays are typically performed yearly. They can happen more often if your dentist is tracking the progress of a dental problem or treatment.

Factors affecting how often you get dental X-rays may include:

1. your age
2. your current oral health
3. any symptoms of oral disease
4. a history of gum disease (gingivitis) or tooth decay

If you're a new patient, you'll probably undergo dental X-rays so that your new dentist can get a clear picture of your dental health. This is especially important if you don't have any X-rays from your previous dentist.

Children may need to have dental X-rays more often than adults because their dentists might need to monitor the growth of their adult teeth. This is important because it can help the dentist determine if baby teeth need to be pulled to prevent complications, such as adult teeth growing in behind baby teeth.

4.3 Risks of dental X-rays

While dental X-rays do involve radiation, the exposed levels are so low that they're considered safe for children and adults.If your dentist uses digital X-rays instead of developing them on film, your risks from radiation exposure are even lower.

Your dentist will also place a lead "bib" over your chest, abdomen, and pelvic region to prevent any unnecessary radiation exposure to your vital organs. A thyroid collar may be used in the case of thyroid conditions.

Children and women of childbearing age may also wear them along with the lead bib.

Pregnancy is an exception to the rule. Women who are pregnant or believe they may be pregnant should avoid all types of X-rays. Tell your dentist if you believe you are pregnant, because radiation is not considered safe for developing fetuses.

4.4 Preparing for dental X-rays

Dental X-rays require no special preparation. The only thing you'll want to do is brush your teeth before your appointment. That creates a more hygienic environment for those working inside your mouth. X-rays are usually done before cleanings.

At the dentist's office, you'll sit in a chair with a lead vest across your chest and lap. The X-ray machine is positioned alongside your head to record images of your mouth. Some dental practices have a separate room for X-rays, while others perform them in the same room as cleanings and other procedures.

5 THERMOMETER

5.1 Introduction

A thermometer is an instrument for measuring or showing temperature (how hot or cold something is). One type of thermometer is a narrow, concealed glass tube containing mercury or alcohol which extends along the tube as it expands. Another type is a digital thermometer, which uses electronics to measure temperature.

Early thermometers from the time of Galileo measured the expansion and contraction of air. After the middle 17th century many used alcohol or mercury. In the 19th century a mechanical thermometer was in invented that used a bimetallic strip to move a pointer. This kind is still popular where people like to read temperature from a distance.

5.2 Laboratory thermometers

A laboratory thermometer is a tool used in laboratories, places where scientists and science techs perform experiments and measure things. A laboratory thermometer can measure temperature very closely. A laboratory thermometer can be put into the liquid or other thing that the scientist wants to measure. A laboratory thermometer has a long stem with a silver bulb at the end. The silver color in the bulb usually means there is mercury in it. Mercury becomes bigger as the temperature becomes hotter. But mercury is a poison to humans. Mercury-in-glass thermometers are less used in the 21st century because people want digital, alcohol-filled, and organic-based thermometers instead.

5.3 Medical thermometers

In the 20th century, the traditional clinical thermometer was a mercury-in-glass thermometer. People put the end of this in their mouth (oral temperature), under their arm, or in their rectum (rectal temperature).

It is only possible to find oral temperatures on patients who can hold the thermometer correctly in their mouth. So small children cannot use this method. It is also a problem for people with a cough or people who are vomiting. In the past it was a big problem because mercury thermometers

needed a long time to measure the temperature. Today's digital thermometers are faster. If a person drinks something hot or cold, one still needs to wait before testing their oral temperature.

When measuring a person's rectal temperature, it helps to use a cream on the thermometer. Rectal thermometers are usually more reliable since they aren't as much influenced by other factors.[1] In some countries people think it is embarrassing to use them for people older than two or three. In other countries, it is considered normal for children and adults to use rectal thermometers.

In the 1990s, people in many countries thought mercury thermometers were too risky, as mercury is dangerous if it leaks out. Today we use electronic thermometers. Sometimes thermometers with liquids are used, but not with mercury.

There are other kinds of medical thermometers: tympanic thermometers test the temperature of the tympanic membrane (the eardrum) with infrared; band thermometers test a person's temperature on the front of their head.