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X-Rays and their Applications in the Medical Field

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Annotation: We learned about x-rays, who is the inventor of x-rays, and why was he called by this name.

We also know the uses of materials used in medicine to make X-ray images of The target of the research bones and internal organs of the body and In the treatment of cancer, as they kill cancer cells easier than killing normal cells. -In industry, X-rays are used to examine products made of different types of materials, including aluminum, steel and other metals, and reveal radiological images For cracks and other defects in these products that do not appear on the surface, and are also used In airports to search for weapons in luggage and in scientific research, X-rays have been used to analyze the arrangement of atoms in many types of materials especially crystals, and the organization of atoms In crystals at Levels separated by regular distances.We also learned about the properties of x-rays and how the x-rays are created in a tube called a sweep tube made of threads made of tungsten wire. We touched on how to detect x-rays and what are the components of the x-ray device .and some of Its types and specifications.

Introduction

X-rays, also called x-rays, are one of the most useful types of energy. It was discovered by the German physicist Roentgen in 1895 AD. And because he did not know about it at first, Roentgen called these rays X- rays, that is, X-rays. Now scientists know that X-rays are a type of electromagnetic radiation that includes visible light, radio waves, and gamma rays. X-rays and visible light share many properties. For example, X-rays travel at the speed of light at 299.792 km/s, and both X-rays and visible light move in straight lines in the form of electric energy and magnetic energy linked to each other called electromagnetic waves. On the other hand, X-rays darken optical imaging films just as light does. However, x-rays and light differ in wavelength, which is the distance between two peaks of an electromagnetic wave. The wavelength of X-rays is much shorter than the wavelength of light. For this reason, X-rays can impede many materials that do not transmit light. X-rays cause biological, chemical and physical changes in materials. If a plant or animal absorbs these rays, they may damage living tissues. Because of this, they can be dangerous. An overdose of X-rays can cause cancer, skin burns, or other serious conditions. Dentists and radiologists must take special care not to overexpose patients or themselves to radiation. X-rays are produced naturally in the sun, stars, and certain other celestial bodies. Most of the X-rays that originate from sources in space are absorbed by the atmosphere before they reach the Earth's surface. X-rays are produced automatically by X-ray tubes, which are a major part of X- ray machines. X-rays are widely used in medicine to make X-ray images of bones and internal organs of the body and in the treatment of cancer, as they kill cancer cells easier than killing normal cells. In industry, X-rays are used to examine products made of different types of materials, including aluminum, steel and other metals, and reveal radiological images For cracks and other defects in these products that do not appear on the surface, and are also used in airports to search for weapons in luggage and in scientific research, X-rays have been used to analyze the arrangement of atoms in many types of materials, especially crystals, and the organization of atoms in crystals at levels separated by regular distances. Among the characteristics of these rays is that their short wavelength electromagnetic radiation contains more energy than long wavelength electromagnetic radiation, and X-rays have shorter wavelengths and higher energies compared to other types of electromagnetic rays. Easily by a mirror as it happens to light because its high energy makes it penetrate the mirror instead of being reflected and does not break, that is, the X-rays do not bend much when they pass from one material to another, and the absorption of X-rays depends more on materials with less density, and if the material absorbs X-rays of sufficient energy They can expel electrons from the atoms of the substance. When the electrically neutral atom gains or loses electrons, it turns into a particle charged with an electric charge called an ion. This process is called ionization. Ionization causes various types of biological, chemical and physical changes, which makes X-rays useful and dangerous at the same time [1]. Research problem **:**The importance of X-rays and their use in particular in medical applications.

Research objectives

X-rays are used for medical purposes, such as imaging body parts such as bone fractures, arthritis, the presence of foreign bodies inside the body, bullet bullets, and others.

The bones of the body absorb X-rays more than the flesh and muscles, and X-rays are used in many days to destroy cancer cells, but this must be done very carefully, as excessive doses cause damage to living tissues or leukemia. Therefore, X-rays are very dangerous and it is always necessary to be careful with X-rays, and exposure to X-rays should be avoided unless advised by a specialist.

1-4 Search Content

This research contains three chapters. The first chapter deals with the research problem, the research objectives, and the research content. The second chapter discusses the characteristics of x-rays, how they are generated, methods of detection, and the x-ray spectrum. Diagnostic x-rays The three chapter deals with the damages of x-rays on the cells and tissues of the human body and ways to prevent them.

1-5 Previous studies: 1.The researchers studied: It is the purpose of this article to explain what it is and to give some examples of how it can contribute to medical science. X-rays have been used for diagnostic medical imaging for more than 100 years and, whilst new techniques such as computed tomography have been developed, the means of producing x-rays has altered little during that time. Synchrotron radiation sources provide multiple, extremely intense and tuneable beams of photons over a huge range of energies from infrared through to hard x-rays [2]. 2.The researchers studied: The magnitude of the risks from low doses of radiation is one of the central questions in radiological protection. It is particularly relevant when discussing the justification and optimization of diagnostic medical exposures. Medical X-rays can undoubtedly confer substantial benefits in the healthcare of patients, but not without exposing them to effective doses ranging from a few microsieverts to a few tens of millisieverts [3]. 3.The researchers studied: November 8, 1995, marked the 100th anniversary of Wilhelm Conrad Röntgen's discovery of x-rays. This remarkable scientific achievement has had an effect on medicine and science that has been matched by few other advances. I will briefly review the events leading up to Röntgen's discovery and the subsequent development of radiology as a discipline [4]. 4.The researchers studied: This paper describes the reactions to those challenges by the medical and the legal professions in the USA. The two professions are treated as connected social institutions, producing ongoing negotiations through which legal doctrines affect medicine no less than scientific discoveries and medical applications affect the law. This joint analysis rewards us with a rich story about an early and overlooked chapter in X-ray history on the professionalization of radiology, the origins of defensive medicine, and the evolution of the legal theory and practice of visual evidence [5]. **5**.The researchers studied: The development of ion beam therapy (IBT) can be seen as a corollary in this continuous endeavor to optimize disease control while minimizing normal-tissue damage. It could not have materialized, however, without the curiosity, ingenuity, and perseverance of researchers, engineers, and clinicians who developed important enabling technologies [6].

2-1 X-ray properties

1. X-rays travel in a straight line at a speed equal to the speed of light.
2. It is not affected by the presence of a magnetic field or an electric field, which indicates that it does not carry any electric charge.
3. The wavelength of the X-rays varies, according to the nature of the cathode metal, between a thousandth of an angstrom 5 A and a thousandth of an angstrom 0.001A.
4. It affects imaging films.
5. It causes fluorination or phosphorylation of some bodies.
6. It has a photochemical effect.
7. It can injure or kill living cells and sometimes cause organic changes in it.

The diversity of these properties has found many important applications. Suffice it to mention [1], for example, the services provided by x-rays in the fields of medical imaging. X-ray generation **:**When electrons moving at a high speed approaching the speed of light collide with a metal target, it results from the sudden stopping of electrons by the atoms of the target material, a kind of rays that have the ability to penetrate the material, which was called X-rays or Roentgen rays in relation to its discoverer Roentgen. The X-rays are generated in a tube called the Couldge tube from a filament made of tungsten wire. Electrons are emitted by heat, and cathode electrons are released towards the target under the influence of a high voltage difference of 105 volts between the cathode and the anode. Despite the high energy of the electrons, they are It does not penetrate the target, but penetrates to a very small depth, and the surface of the target becomes the source of the X-rays.

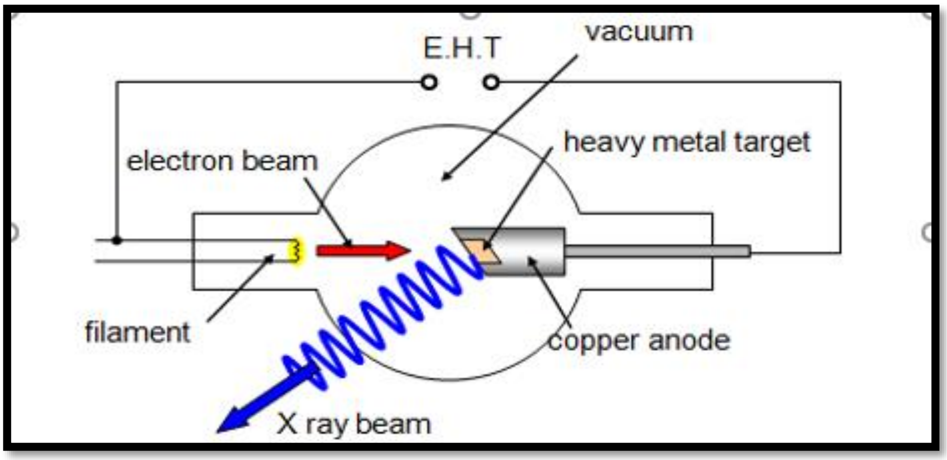

Fig.(1) X-ray generation method.

2-2 The idea of making an x-ray generator

X-rays are produced when high-energy electrons are exposed to a sudden loss of energy, and the X-ray production devices increase the speed of the electron to very high speeds, then ... make it hit a piece of solid material called the target, then the electrons suddenly slow down due to their collision with atoms in the target, and part of their energy turns into X-ray [7] .

2-3 Installing an x-ray generator

1. a vacuum tube.
2. A filament of a metallic element in which electrons are emitted when heated. This phenomenon is called thermal emission.
3. High potential difference to accelerate the electrons.
4. A target made of tungsten.

2-4 X-ray measurement and detection

X-rays can be detected or measured using one of the following x-ray properties:

1- When radiation passes through a gas, it ionizes.

2- The effect of photographic panels when exposed to X-rays.

3- It causes a flash when it falls on some special panels.

The ionization property is usually used in studies and research related to physics when measuring or recording these rays, and as an application to that, the Geiger-Muller counter is used, while properties 32 are used in the field of industrial and medical purposes .

2-5 X-ray spectrum

When studying the X-ray spectrum, it was found that it consists of a continuous spectrum, and separate lines with specific positive lengths (linear). These rays were interpreted according to the Bohr model as follows: Continuous spectrum: Electrons have kinetic energy, and when they hit the target, as a result of their interaction with the atoms of the target material, their speed decreases, and thus their kinetic energy decreases. Varying amounts of energy emit photons of different lengths.

The connected spectrum depends on:

Potential difference inside the tube "The lowest wavelength in the spectrum band is called the cut-off wave".

Linear spectrum: It results if one of the accelerated electrons collides with one of the electrons in the internal energy levels of the target atom. If the accelerated electron has sufficient kinetic energy, it can liberate the electron in the internal level. As a result, the electron moves from the external energy levels of the target atom to the internal level to fill the void. The transition process is accompanied by the emission of a photon with a specific energy equal to the energy difference between the two levels. The linear spectrum depends on: the target material [8].

2-6 photoelectric phenomenon: This phenomenon occurs when the energy of the photons is slightly greater than the binding energy of the electron in the orbit) with the atom. In this case, the probability of photons interacting with the inner electrons of the atom is great (80%) with the electrons of the orbit (K) and (20%) with the electrons in the other orbits. The photoelectric phenomenon has advantages and equal when diagnosing with X-rays. One of these advantages is a very good quality image, because the X- rays are all absorbed by the material, the living tissues of the body (and some of them are not dispersed. The possibility of this phenomenon occurring depends greatly on the atomic number of the material. The image between different tissues is great, but the disadvantage of this phenomenon is the high dose that the patient is exposed to, because all photons are absorbed.

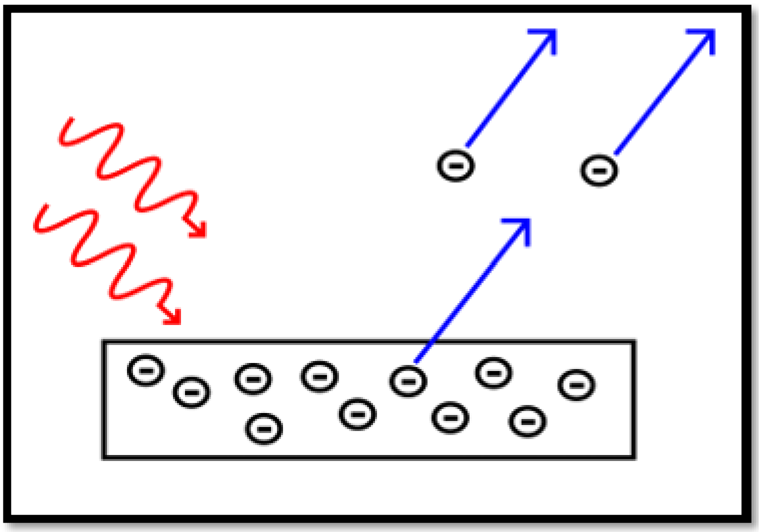

Fig.(2) photoelectric phenomenon.

2-7 production of pairs

This phenomenon occurs when the energy of the photons is very large, as the photon passes through the field of the nucleus, and as a result of the electric field of the nucleus, the photons disappear and the energy is transformed into a substance in the form of an electron- positron pair. This phenomenon is not important in X-ray interactions in medical diagnosis [9].

2-8 X-ray absorption

The absorption of an X-ray beam through the medium through which it traverses is governed by the following relation:

I=Ioe-mx

Io It is the initial intensity of the radiation beam and it is the final intensity of the beam after passing through a thickness of X of the material and m is the absorption coefficient. This law applies not only to x-rays but also to gamma-rays as well as to light rays, but m of course depends on various factors.

Two of the main processes that occur when absorbing X-rays and γ- rays are two processes: the photoelectric effect and the cometon effect. In the first process, the photon is completely destroyed, giving up part of the energy to liberate an electron from the atom or from the molecule. Either the remaining part of the energy is gained by the liberated electron as kinetic energy. In the second process, the photon is scattered as a result of its collision with a mentally free, distant electron. The photon continues to present it, but with a lower energy. As for the electron, it gains a kinetic energy equal to the difference in energy of the photon before and after its collision. The photoelectric effect is at its greatest degree when the photons are of low energy. This effect increases rapidly with the increase of the atomic number of the material medium. But the cometon effect, on the other hand, does not change much. The energy of the photon changes, and is directly proportional to the atomic number. In biological tissues, the cometon effect prevails if the energy of the photons is 0.3mev or more. It should be noted here that the scattering rays resulting from the kometon effect are rapidly absorbed by the photoelectric effect.

A third effect becomes significant when the energy of the photons is greater than 1mev. This effect indicates pair generation. Here, the photon perishes after giving up all its energy to form a pair of a negative electron with a positive electron. A part of its energy is used by the photon to create the two particles, and the other part is gained by the two particles as kinetic energy. In living tissues, where the atomic number is low, this effect will have little significance [10].

3-1 X-ray device

The radiographic imaging device mainly consists of a tube for generating x-rays, an image acceptor, a high-voltage electrical supply generator, in addition to a control and operation group. Some complementary tools and devices are added that help in the diagnosis process according to the case studied, as the devices differ from each other according to the nature of use, but they all depend on The basic principles discovered by Roentgen.

The X-ray beam emitted from the focus is emitted in the X-ray tube and then passes through the limiters of the radiation beam to penetrate the human body and finally reaches the film after passing through the network that prevents the passage of scattered rays that lead to distortion of the radiological image. After developing the film, we obtain the radiological image [11].

Fig. (3) X-ray device

3-2 Types of radiological imaging device **:** Ordinary Imaging Devices:

Ordinary imaging means taking a photograph using X-rays of an area of a person and printing it on a photographic film to show the pathological condition, which is often used for imaging different parts of the body such as limbs, ordinary chest x-rays, imaging of the skull, imaging of fractures, and this is given A normal image, depending on the size of the part to be photographed [12].

Endoscopes .

Computerized tomography devices .

Breast imaging devices.

Imaging of veins, arteries and interventional tissues.

3-3 Components of the X-ray machine

X-rays are produced when accelerated electrons fall on a substance and lose their energy as a result of ejecting electrons as they pass through the nucleus or interact with the atom as a whole. This is done by using two electrodes, one the cathode and the other the anode, which are kept inside a glass tube emptied of air .

3-3-1 **:**cathode

It consists of a tungsten filament connected to a low voltage (10 volts) to heat the cathode and emission of electrons from it according to the phenomenon of thermal ion emission (Edison effect). The filament is heated to about 2200 degrees Celsius in order to emit electrons that gather near the cathode in the form of a cloud forming what is called the vacuum charge. This cloud of electrons prevents the rest of the electrons from emitting from the fuse until it has energy that can overcome the energy of the vacuum charge.

Electrons emitted from the cathode repel each other according to Coulomb's law. Therefore, the electron beam falls over a wide area. This phenomenon can be prevented and the beam narrow by using a focusing cup that surrounds the filament and connects to a negative voltage in order to affect the electrons emitted from the filament with a force of repulsion and collect the beam In a small space, the bowl is usually made of nickel.

3-3-2 Anode: It is that part of the X-ray that is connected to a high positive voltage that attracts the electrons emitted from the filament with great force. The area of the anode that is bombarded with electrons is called the focal area, and whenever the focal area is large, the heat resulting from the collision of the cathode electrons with the anode will be distributed over a larger area and reduce the possibility of melting the anode [13].

3-4 Filters **:**X-rays contain multiple energies, so when they fall on the patient's body, the low-energy rays are completely absorbed during the first centimeters of the body according to the photoelectric phenomenon. The image of the organs penetrated and the dose received is relatively small. Therefore, the received dose can be reduced by absorbing low-energy X-rays before they reach the patient's body. This can be achieved by placing a filter between the X-ray tube and the patient's body. the patient's body and have no benefit in radiography. The use of filters placed in the path of radiation beams leads to hardening of the radiation beam and increasing its transmittance, which, despite its simplicity and lack of capacity, affects very effectively in improving the image and reducing the radiation dose for patients. In the process of radiological examination, the X-rays are filtered in three ways .

3-4-1 Basic filters: The filtering of the X-rays occurs as a result of their passage through the components of the X-ray tube, and this filtration cannot be eliminated because a large part of the X-rays is filtered when it passes through the glass or metal sheath, the cathode, the anode, the insulating oil that surrounds the X-ray tube, and finally in the window from which it exits. X-rays, which are often made of Mylar. All of these filters are equivalent to an aluminum filter whose thickness ranges between (1-0.5) mm. In some cases, especially when the X-ray energy is low, this filter is not useful because it reduces the contrast of the image and we get a radiological image of not good quality. Therefore, the window is replaced with beryllium (number) atomic number (4), in which filtering at low energies of x-rays is as low as possible [14].

3-4-2 Heavy metal filters:

The use of an aluminum filter leads to the absorption of low energies and the penetration of a wide range of X-ray energy through this filter. In order to reduce the range of the energies of the rays penetrating from the filter, heavy metal filters are used. These filters determine the range of the energies transmitted within the absorption edges (absorption - edge). Thus, we obtain an image with good contrast [15].

The basis of the work of heavy metal filters such as molybdenum, alkadolinium and tungsten is to pass a narrow range of X-ray energy, as it absorbs both low and high energies and passes the energy of the K absorption edges because the absorption of low energy reduces the patient dose. The absorption of high energies leads to a clear contrast image. Because these filters absorb a quantity of high-energy X-rays, the exposure coefficient (MAS) must be increased (the product of the current and the exposure time) to equal the high-energy absorption.

3-5 Automatic control unit for exposure time to radiation doses

It is done according to the quality of the image to be taken, as well as according to the body's different coefficients of density and area, and the radiation dose control device is manufactured in a way that enables it to determine the necessary time through which radiation doses are directly delivered to the examined body so that the image can appear on the film and the automatic device is used for this The process is measurement signals by which the required time can be controlled according to the equation [16]: Radiation dose = Power dose * Exposure time

In order to determine the dose capacity, a measurement unit sensor is used, which is installed directly in front of the film.

The automatic control device is installed in accordance with the equation: Exposure time = constant / ionic current

This equation provides the correct required time. It is possible through the change of the constant to determine the sensitivity of the film used, as well as the amplification plate can be taken into account.

3-6 Roentgen fittings

Radiographic application equipment is a device used to achieve compatibility between the Roentgen beam, the patient and the image generating set.

The main parts include stative or radiation guide, patient lying table, image display group containment unit. And the forms of manufacturing or installation of the equipment allow defining the field of use [17].

3-7 Standard specifications for diagnostic x-ray machines The electrical circuit that feeds the device must be directly connected with the main control board and bear the burden of operating the device with the highest power. There must also be protection against overloading as a result of frequent use or use for long periods of time, and protection from exposure for a long time as a result of any defect in the timer.

Protection from the risk of electric shock.

The cover that protects the radiation tube must be designed so that the levels of radiation leaking from it do not exceed (100mR) at a distance of one meter from the radiation source and during operation for a full hour or (2.5Gy/mAsm) for a single exposure at the highest operating conditions, and a mark must also be present on the outer surface of the cover The radiation tube protector shows the location of the radiation source. A system must be available to determine the radiation field according to what is required clinically. This system has the ability to absorb the main radiation with the same capacity as the radiation tube protective cover. The distance from the radiation source to the surface of the patient's body must not be less than (30 cm) with the presence of A convenient way to measure distance [18].

3-8 Performance calibration of normal imaging x-ray devices: The maximum allowable error percentage in the voltage difference should not exceed 5%, and the maximum allowable error percentage in the exposure timer should not exceed 5%. At a constant voltage difference, the dosage amount should be proportional to milliampere seconds linearly for all values of milliampere and time, and the dose amount should be constant and within the range of 20, preferably 10% for all values of current intensity and exposure time at any fixed value for each of milliamps per second and the voltage difference, and the error rate between the fluorescence determination illumination and the actual ray field should not exceed 2% of the distance between the ray source and the film, and the exposure level of the scattered rays should not be more than 2.5mR/mAs or 0.01mGy/ hr. Also, the total equivalent filter thickness (internal + added) must not be less than 1.5mm of aluminum for a voltage difference of less than 70Kv, and a thickness of 2mm of aluminum at a potential difference that the actual area of the focus in the radiation source does not exceed 2mm2 in any way [19].

3-9 The effect of x-rays on normal cells :The first phenomenon in the cycle of the effects of X-rays on living cells is a purely physical phenomenon. The meeting of x-ray photons with electrolytes of atoms and molecules of chemical substances present in the cell leads to one of the following two phenomena: The liberation of an electrolyte from one of the atoms, which becomes an ion. - Electron absorption of the energy of the X-photon and its transfer to a higher energy level inside the atom - the same one that transforms into an excited atom. The properties of the ion and the excited atom differ from the properties of normal atoms that have not been exposed to X-rays. Thus, the properties of protein change due to necessity, and its molecules may turn into molecules of other substances that are simpler than protein molecules. This means the presence of substances foreign to the living cell that lead to a change in the shape and function of the cell itself. In this regard, the following observations can be drawn:

A. After cells are exposed to X-rays, changes appear after a latency stage, i.e. after a period of exposure has elapsed. This period could be very short if we could accurately know the chemical and biological changes in matter. And it can be long if we consider that the changes are limited to death or the occurrence of a clearly visible defect, such as dermatitis, for example. We can respond to this latency by saying that the chemical changes caused by X-rays in the cell nucleus accumulate gradually so that their effect does not appear until after completion. B. The ability of the cell to breathe diminishes after long exposure to X-rays, according to the opinion of many who have worked in this field. C. The speed of normal cell division is less than the speed of cell division of malignant tumors. This means that X-rays kill tumor cells more than normal cells. D. The effect of X-rays on cells does not change with wavelength change, despite the observation that unilateral rays of wavelength are more destructive than rays of multiple wavelengths [20].

3-10 :The effect of X-rays on the tissues of the human body Depending on the change of the dose value of the X-ray beam, four degrees of skin injury can be determined. First degree: no inflammation appears on the skin, then the hair falls out, then the skin color changes. This condition lasts from two to four weeks, and then it recovers completely. Second degree: moderate skin rash, clear expansion of blood vessels, a feeling of high temperature in the affected part, hair loss with skin discoloration. The infection lasts from six to twelve weeks, with the possibility of recovery and skin discoloration. Third degree: a red-blue skin rash, hair loss, death of the sweat glands, and a feeling of pain. The infection lasts between eight and sixteen weeks, and recovery takes place, leaving clear traces of the skin, without a single hair growing. There is a possibility of complications occurring many years after the injury. Fourth degree: a bluish rash tending to redness, the appearance of blisters and what looks like ulcers, and terrible pain, and there is doubt about the possibility of recovery.

3-11 Principles of radiation protection

Justify the practice

It means that work should not be initiated in any actions or practices that include the use of radioactive materials or devices that emit ionizing radiation unless these actions lead to sufficient benefit for the exposed persons or society as a whole that justifies the radiation damage that may result from them.

Radiation protection examples: After working with radioactive materials or devices that emit ionizing radiation is justified, this work is done at the lowest possible level, so that we keep the exposure doses at a minimum, taking into account economic and social factors. Radiation protection examples: After working with radioactive materials or devices that emit ionizing radiation is justified, this work is done at the lowest possible level, so that we keep the exposure doses at a minimum, taking into account economic and social factors. exposure limits: After the practice and protection examples have been justified, the exposure of persons must be subject to certain limits that may not be exceeded, namely: A. Occupational exposure is the exposure that workers face as a result of the requirements of their permanent or temporary jobs. Temporary workers, workers under training, students who are exposed to radiation as a result of the study, and trainees between the ages of eighteen and sixteen over eighteen. An effective dose for the whole body is 20 millisieverts per year, and it can be exceeded to 50 millisieverts, so that it does not exceed 100 milliseverts during 5 years. 150 mSv is an intraocular dose equivalent. 500 mSv equivalent dose for the skin and extremities. Between eighteen and sixteen. Students and trainees 6 mSv effective dose for the whole body. 50 mSv equivalent dose for the eye lens 150 mSv equivalent dose for the skin and extremities [21] . B.medical exposure, which is the exposure that occurs to the patient during examinations that include the use of a radioactive substance or a radiation source device. There are no specific limits for medical exposure, but it is required that the desired benefits from the examination be sufficient and greater Among the possible harms, and that the examination be carried out at the lowest level that can be achieved, and the exposure of those accompanying the patient, if it is necessary for them to stay with the patient, is considered one of the medical exposures. The exposure of doctors or nursing staff is not considered a medical exposure, but rather it is considered an occupational exposure. C. Exposure to the public (the general public), which is the exposure that will be faced by the general public who have no relationship with the establishment. You should not exceed their doses of the following: 50 mSv for the skin and extremities 15 mSv for the lens of the eye 1 mSv is an effective dose for the whole body. D. Pregnant workers, the dose to the fetus should not exceed 1 millisievert, as it is treated as a general population, and the dose on the abdomen of a pregnant worker should not exceed 2 millisieverts during pregnancy.

3-12 The perfect x-ray room: Technologies developed for calculating the necessary shielding thickness from the dangers of X-rays in the twenties of the last century, and the required thickness for shielding was identified in terms of the half-value layer HVL, and the shielding requirements have recently become more stringent due to the shrinking exposure standards for workers in the field of radiation, as well as the general public, and it has accumulated over a hundred years A large amount of shielding data for medical X-ray generation equipment has been collected, and that data is used in the form of tables or graphs with simple equations to predict the shielding thickness needed for shielding. When designing the X-ray room, the protection of workers inside and outside the room must be taken into account, in addition to the protection of workers who are not classified by radiation (nursing - secretarial users) and the general public outside the room so that the exposure rate does not exceed the permissible limit for each category. We must also take into account the ease of entry movement The exit of the medical staff behind the armored barriers that includes the control unit and the operation of the x-ray machine, and the radiation beam must be determined to reduce the rate of exposure of the adjacent room [22].

Conclusion:

In summary, X-rays are electromagnetic waves, and X-rays have become nowadays of great importance in various fields of life. We find that X-rays are used in airports to inspect bags and check the quality of products. They are also used in the field of medicine on a large scale, as they are used to detect fractures. In bone and dental abnormalities it is also used in detecting traces and organizing crystals. From the previous it is clear to us that although x-rays have advantages, they have harms as they affect the human body and cause disorder in cells and cause skin cancer, so we must limit the use of x-rays.

Recommendations

In conclusion, we thank God for what He helped and facilitated. Praise be to Him first and foremost, for His blessings and His renewed bounties, and He is the owner of grace and blessings. Then we commend some recommendations:

1-Using lead barriers because X-rays cannot penetrate bullets.

2- Directing X-rays towards the target spot only instead of.

3- It is not permissible to use x-rays unless adequate protection is provided for all persons.

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