

INTRODUCTION TO RADIOLOGY

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GENERAL TERMINOLOGY

Radiology (Roentgenology): It is a branch of medical science which deals with diagnostic and therapeutic applications of radiant energy particularly of X-rays, beta and gamma rays.

Radiologist: A person qualified in medical or veterinary sciences as well as radiological physics to use radiant energy in the diagnostic, therapeutic and research fields of medicine.

Radiographer/ skiagrapher: A person trained to operate X-ray machine in a specified safe manner to obtain quality radiographs for the use by the radiologist.

Radiograph (Roentgenogram/ skiagram/ X-ray picture): Photographic record of the extent of penetration of X-rays through the exposed tissue parts.

(The term skiagram and skiagrapher were used until about 1918 and now these terms are obsolete.)

X-rays: A special type of electromagnetic radiation which has high energy, extremely short wavelength, no mass or charge and travels at the speed of light.

HISTORICAL PERSPECTIVES

1870s	<ul style="list-style-type: none"> ▪ Johann Hittorf observed tubes with energy rays extending from a negative electrode. These rays produced a fluorescence when they hit the glass walls of the tubes. ▪ In 1876 the effect was named "<u>cathode rays</u>" by Eugen Goldstein(Now a day these are known to be streams of electrons). ▪ William Crookes constructed the Crookes tube and noted that cathode rays caused the glass walls of his tube to glow a dull blue colour. Crookes however, failed to realize that it wasn't actually the cathode rays that caused the blue glow, but the low level x-rays produced when the cathode rays struck the glass.
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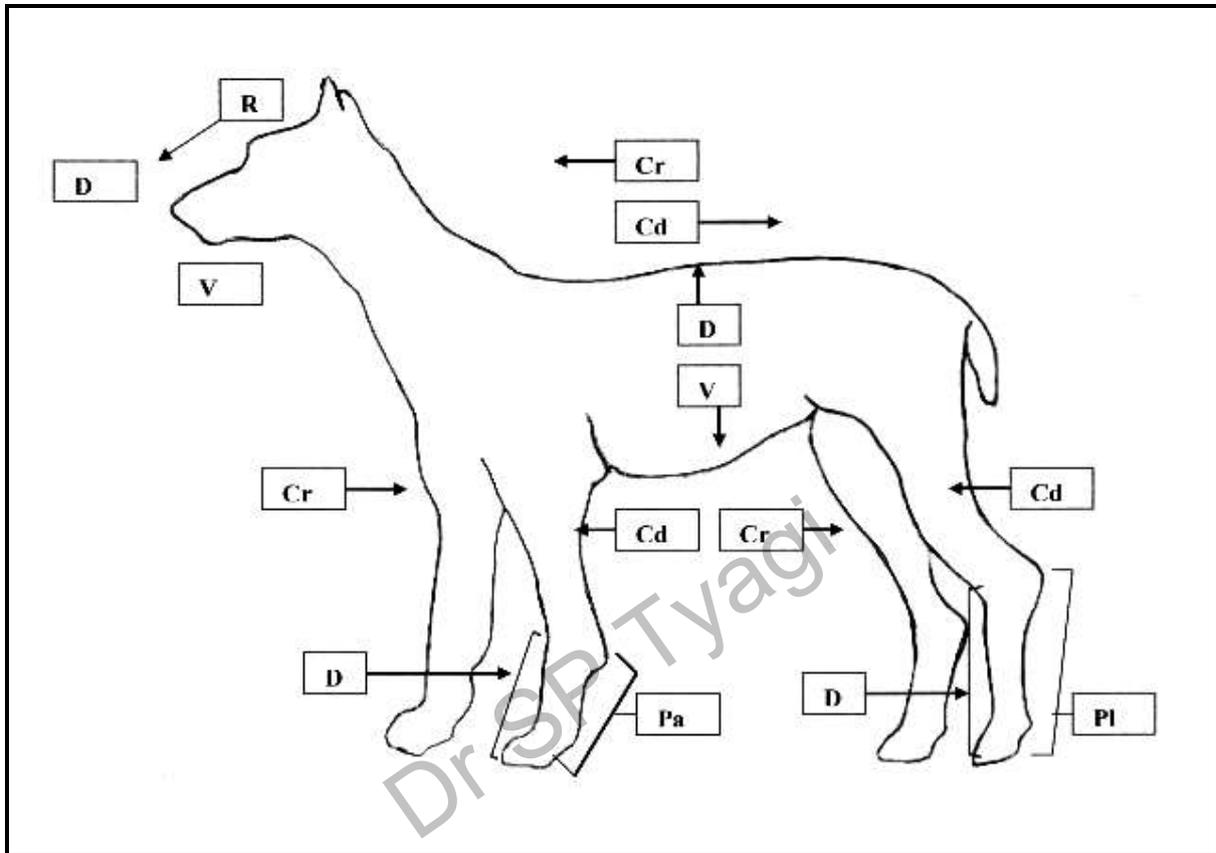
1880s	<ul style="list-style-type: none"> ▪ Ivan Pulyui reportedly developed an X-ray emitting device “the Pulyui lamp” as early as 1881 and demonstrated an X-ray photograph as well. However, he could not clarify his ideas and convince the scientific fraternity and hence later Wilhelm Conrad Röntgen went on to be credited as the major developer of the technology. ▪ Nikola Tesla developed a special single-electrode X-ray tube in April 1887. The principle behind Tesla's device is nowadays called the Bremsstrahlung process, in which a high-energy secondary X-ray emission is produced when charged particles (such as electrons) pass through matter but he generalized the phenomenon as radiant energy of "invisible" kinds. (However, these emissions were later called X-rays).
1890s	<ul style="list-style-type: none"> ▪ In 1892, Hertz demonstrated that cathode rays could penetrate very thin metal foil (such as aluminium). ▪ Wilhem Conrad Roentgen accidentally discovered X-rays while working on Crooks tube on November 8, 1895. ▪ Thomas Edison investigated materials' ability to fluoresce when exposed to X-rays and developed fluoroscope for medical X-ray examinations in 1895. ▪ Roentgen and coworkers developed first metal-target x-ray tube in 1896 ▪ First photographic paper developed by Wright to record X-rays image in 1896. ▪ First veterinary radiograph of an equine foot published by Paton and Duncan in 1896. ▪ First intensifying screen made by Pupin in 1896. ▪ X-ray were used extensively to locate bullets in the bodies of soldiers in Greco-Turkish and Sudan-Boer war in 1897. ▪ Cannon used X-rays for contrast studies using bismuth meals to investigate physiology of gastro-intestinal tract in 1898.
20 th century	<ul style="list-style-type: none"> ▪ The Roentgen Society of United State was formed in 1900 ▪ Roentgen received first noble prize in physics for the discovery of X-rays in 1901 ▪ G.H. Knecht developed first dosimeter for radiation therapy in 1902 ▪ In 1904, Flemming invented the thermionic diode valve (tube). This used a heated cathode which permitted current to flow in a vacuum. The principle was quickly applied to x-ray tubes, and hard vacuum heated cathode x-ray tubes completely solved the problem of efficiency reduction.

<ul style="list-style-type: none"> ▪ In 1906, Charles Barkla discovered that X-rays could be scattered by gases, and that each element had a characteristic X-ray. He won the 1917 Nobel Prize in Physics for this discovery.
<ul style="list-style-type: none"> ▪ Max von Laue, Paul Knipping and Walter Friedrich observed for the first time the diffraction of X-rays by crystals in 1912.
<ul style="list-style-type: none"> ▪ The Coolidge tube was invented by William D. Coolidge in 1913, which permitted continuous production of X-rays; this type of tube is still in use today.
<ul style="list-style-type: none"> ▪ Gustav Bucky invented grid to remove scatter radiation in 1913
<ul style="list-style-type: none"> ▪ Moving grid invented by Dr. Hollis Potter. (1920-25) ▪ Iodine compounds introduced for use as contrast agents.
<ul style="list-style-type: none"> ▪ First international recommendations on radiation safety precautions were published in 1928
<ul style="list-style-type: none"> ▪ Gray Schnelle wrote first American book on Veterinary Radiology in 1945
<ul style="list-style-type: none"> ▪ First radiographic film with polyester base was developed in 1960. ▪ American Board of Veterinary Radiologists formed in 1960.
<ul style="list-style-type: none"> ▪ Rare earth intensifying screens invented in 1972. ▪ Computerized Axial Tomography (CAT SCAN) developed by G.N. Hounsfield in 1972.

USES OF RADIOGRAPHY IN VETERINARY SCIENCE AND PRACTICE

1. As a diagnostic aid.
2. To select methods or techniques of treatment e.g. for the fracture repair
3. To monitor efficacy of the treatment.
4. To screen normal animals for morphological evaluation in an attempt to eradicate inherited diseases by selective breeding.
5. To determine the age of the animals
6. To examine postmortem material
7. For non-destructive examination of archaeological specimens of animal origin.
8. As teaching aid in the subject of anatomy.
9. In veterinary research e.g. osteomedullography to evaluate bone healing.

DIRECTIONAL TERMS USED FOR VETERINARY RADIOGRAPHY: The various directional terms used in radiographic work are described below with their standard abbreviations. These are based on the recommendations of the nomenclature committee of American College of Veterinary Radiologists {ACVR}-



1. Cranial (Cr):

- ☞ It describes the part of the neck, trunk and tail positioned towards the head from any given point.
- ☞ It also describes aspects of the limb facing head and above the tarsal and carpal joints.

2. Caudal (Cd):

- ☞ Parts of the head, neck and trunk positioned towards the tail from any given point.
- ☞ It also describes aspects of the limb facing tail but proximal to carpal and tarsal joints.

3. Dorsal (D):

- ☞ It describes the upper aspects of the head, neck, trunk and tail, also meaning towards the back or vertebral.
- ☞ It replaces cranial distal to carpal and tarsal joint.

4. Ventral (V):

- ☞ It describes lower aspect of the head, neck, trunk and tail, also meaning towards lower aspect of the animal.

5. **Rostral (R):** It describes the parts of the head positioned towards the nares from any given point on the head.
 6. **Palmer (Pa):** It replaces caudal in the fore limbs from the carpal joint distally.
 7. **Planter (Pl):** It replaces the caudal in hind limbs from tarsal joint distally.
 8. **Lateral (L):** It describes any part positioned away from the median plane of body.
 9. **Medial (M):** It describes any part positioned towards the median plane of body.
 10. **Proximal (Pr):** It describes nearness to the point of origin of a structure.
 11. **Distal (Di):** It describes a point farther away from the point of origin of a structure.
- ★ The terms superior and inferior are also used to describe upper and lower dental arches in cases of dental radiographic views.
 - ★ The anatomical terms Anterior, Posterior and volar are no longer used for radiographic directions.
 - ★ These above mentioned directional terms are based on the principle that each radiographic view should be able to indicate the direction that the central ray of the primary beam of the X-rays penetrates the body part being examined *i.e.* from the point of entrance to the point of exit.
 - ★ Therefore while writing down the radiographic view, directional terms of both, the point of entrance and the point of exit should be mentioned *e.g.* ventrodorsal, dorsopalmer etc.
 - ★ For complex terms as in case of oblique views a hyphen is added to indicate the point of entrance and exit of the central ray *e.g.* dorsolateral- palmeromedial oblique.

TO WRITE RADIOGRAPHIC VIEW OF ANY GIVEN STRUCTURES

- ★ Right or Left should precede other terms *i.e.* Left cranioventral.
- ★ Medial and lateral should be subservient when used in combination with other terms *e.g.* dorsomedial.
- ★ On the limbs the terms dorsal, palmer, planter, cranial and caudal should take precedence when used in combination with the other terms *e.g.* dorsoproximal, palmarodistal.