Radiography of Bone

P Shah Navas

Research Cell, Kerala State, IMA*

ABSTRACT

Published on 30th December 2008

Introduction: When the x-rays pass through the body they are weakened by the many types and layers of tissues. Bone being denser, absorbs a greater amount of radiation and they appear more prominently (e.g. whiter) than soft tissue.

Objective: Review on X ray and other imaging techniques of bone.

Result: Bone x-rays are the fastest and easiest way for a physician to view and assess broken bones and joint and spine injuries, images for diagnosis and disease management and is particularly useful in emergency diagnosis and treatment.

Keywords: Bone, X-Rays

*See End Note for complete author details

In 1895 W.C Roentgen invented roentgenograms, which today are simply referred to as x-rays or radiographs. Although x-rays have evolved over the years, the principle remains the same except that today's techniques utilize only a fraction of the x-ray doses used in the early days of radiology. The x-ray technology is the 'workhorse' of fundamental diagnostic imaging. Testing is fast, easy, and painless. When the x-rays pass through the body they are weakened by the many types and layers of tissues. Bone being denser, absorbs a greater amount of radiation and they appear more prominently (e.g. whiter) than soft tissue. The energy is directed into a film cassette placed behind the targeted body part, held behind an intensifying phosphor screen. The screen absorbs x-rays, gives out light and exposes the film, which is subsequently processed to form a final image in much the same manner as a photographic film.

Bone X-ray (Radiography)

Conventional X-rays: Although x-rays have evolved over the years, the principle remains the same except - today's techniques utilize only a fraction of the x-ray dose required in the early days of radiology. It encompasses a wide range of techniques and applications. However, in general, x ray imaging is broken into two major categories:

1. Radiographic imaging where a "still image" is made of a bone or organ and shown on film or on a computer screen. A radiograph may be likened to taking a picture with a 35 mm camera.
2. Fluoroscopic imaging where a "movie" is made of an organ (for example, swallowing) and viewed on

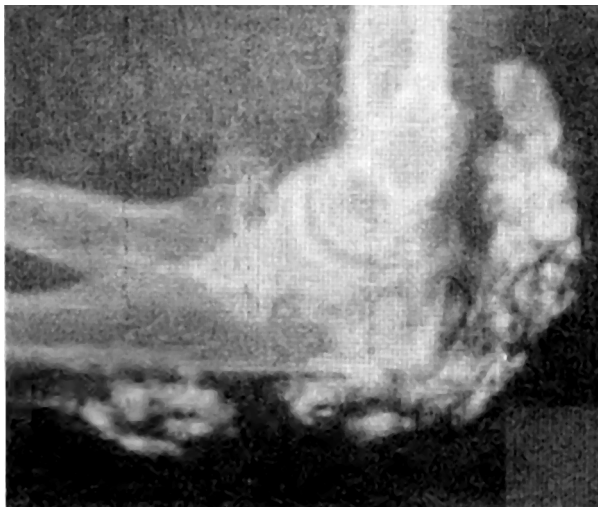

Figure 1. **Tumor calcification around the elbow**

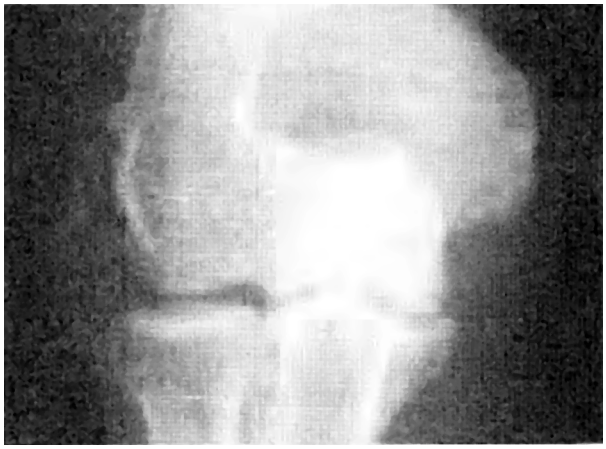

Figure 2. **Normal X-ray of Elbow AP view**

Corresponding Author:

Dr. P Shah Navas, Convener, Research Cell, Kerala State, IMA. TC 7/171, Kumaran Asan Nagar, Ulloor, MCPO, Trivandrum –695011. Phone: 9447169693. Email: drshahnavas@gmail.com

a TV monitor or computer screen. (fluoroscopy) Plain radiographs in orthopedics allow

- assessment of joint space narrowing, sclerosis osteolysis
- osteoarthritic degeneration (osteophyte formation, subchondral cysts),
- post-traumatic deformity, calcified loose joint bodies,
- pericapsular calcifications, erosions, infections,
- fractures, dislocations, and trauma imaging
- osteochondritis dissecans, developmental dysplasias,
- tumors and allied conditions
- orthopedic implantation & appliance position checking etc. X-ray images are maintained as hard film copy (much like a photographic negative) or, more likely, as a digital image that is stored electronically. These stored images are easily accessible and are sometimes compared to current x -ray images for diagnosis and disease management. The patient may be re positioned for another view and the process is repeated. At least two images (from different angles) will be taken and often three images are needed if the problem is around a joint (knee, elbow or wrist). An x-ray may also be taken of the unaffected limb, or of a child 's growth plate (where new bone is forming), for comparison purposes.
- The patient will be asked to wait until the technologist determines that the images are of high enough quality for the radiologist to read.

What are the benefits vs. risks?

Benefits

- Bone x-rays are the fastest and easiest way for a physician to view and assess broken bones and joint and spine injuries, images for diagnosis and disease management and is particularly useful in emergency diagnosis and treatment.
- X-ray equipment is relatively inexpensive and widely used in all settings, making it convenient for both patients and physicians. No radiation remains in the body after an x-ray examination with usually with no side effects.
- An invaluable tool for quick assessment or a better differential diagnosis in emergency room setting to give a greater diagnostic accuracy

Risks

- There is always a slight chance of cancer from radiation. However, the benefit of an accurate diagnosis far outweighs the risk.
- During a single x-ray exposure, a patient is exposed to approximately 20 milliroentgens of radiation. We are all exposed to approximately 100 milliroentgens of radiation each year from sources like the ultraviolet rays of the sun and small traces of background radiation such as uranium, in the soil.
- Women should always inform prior to X-ray exam if there is any possibility of pregnancy.

What are the limitations of X-rays?

While X-ray images are among the clearest, most detailed views of bone, they provide little information about the adjacent soft tissues. MRI scans are more useful in identifying ligament tears and joint effusions in knee or shoulder injuries and in imaging the spine, because both the bones and the spinal cord can be evaluated. MR I can also detect a bone bruise when no crack is visible on x-ray images. Ultrasound imaging, which uses sound waves instead of ionizing radiation. has also been useful for injuries around joints and in evaluating the hips of newborns, infants and children.

The Differences between MRI and X-Rays

The main differences between an x-ray and an MRI are the images they produce. An x-ray clearly shows the contrast between soft tissue and bone density. So it is often used to examine broken bones. An MRI image shows a better contrast between different kinds of soft issue and produces detailed images of the brain and other tissues.

MRI is still a relatively new procedure when compared

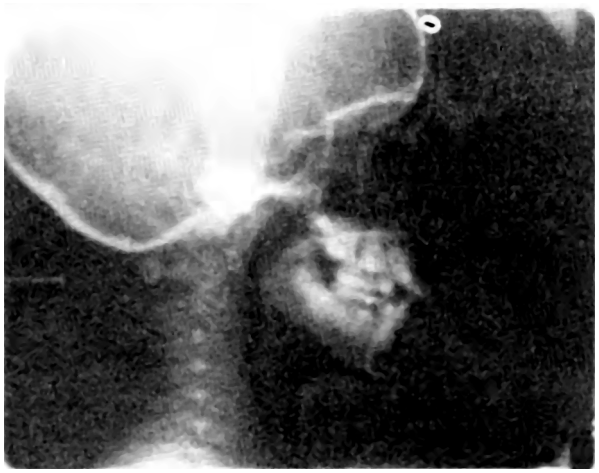

Figure 3. **Digital Radiograph of Skull lateral view**

Figure 4. **MRI Picture of Skull lateral view**

to x-ray. At this point, there are no known biological hazards associated with the MRI. MRI is more versatile than x- ray also, as it can be used to examine a wider variety or medical conditions. MRl does have a few disadvantages though. People w h o are claustrophobic have difficulties staying in the enclosed area. Most patients are un comfortable staying still during the exam, which can last up to 90 minutes. Also, MRI machines usually have a weight limit of around 500 pounds and so obese people cannot he examined. Patients with pacemakers or other metal objects in their body usually can not be examined through MRI either, due to the extremely powerful magnets used. MRI is much more expensive than other methods of examination also including x ray.

Digital Imaging

Digital imaging is still not a universal tool in orthopedics. but more practices are recognizing its benefits and gradually implementing its technology despite some cost and reimbursement constraints. Digital imaging will eventually eliminate plain film to become the universal method. Whether their practices have "gone digital" or not, most orthopedists now agree that plain X-ray film images will one day become obsolete. In the meantime, all are keeping an eye on the latest technology to prepare for the time when every office and hospital uses digital systems.

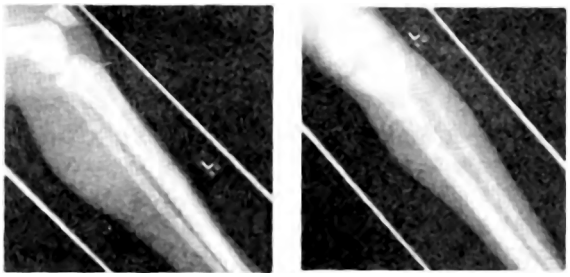

Figure 5. **Digital X-rays**

It cuts costs significantly for printing supplies, office space, and access to the digital images is instantaneous.

Figure 6. **The radiologist views the results of fluoroscopic examination of the upper GI in real time using a digital acquisition**

Digital radiography is currently practiced through the use of three commercial approaches, two of which also depend on phosphor screens. The first phosphor based approach is to digitize the signal from a video camera that is optically coupled to an x-ray image intensifier to provide an instant readout. The flat panel detector coated with an x-ray photoconductor such as a-Se provides one of the best ways to realize the benefits of digital radiography.

The a-Se method has potential for use in fluoroscopy (real-time interactive x-ray imaging) In fluoroscopy a video image on the monitor enables the radiologist to see a moving x-ray picture of the inside of the human body.

Digital (or computerized) imaging techniques carne to x-ray in the 1980s when analog to digital (AID) converters and computers were also adapted to conventional fluoroscopic image intensifier/TV systems. Many of the fluoroscopic ("fluoro" for short) x-ray procedures described herein have benefited greatly from the addition of digital technology. Further, angiographic procedures for looking at the blood vessels in

Figure 7. **The digital x-ray image from the fluoroscopic GI study shows a normal stomach**

the brain, kidneys, arms and legs, and the blood vessels of the heart all have benefited tremendously from the adaptation of digital technology.

Digital Radiography

Using a new adaptation of CCD (Charge Coupled Devices) imaging technology originally developed for space exploration, x-ray images are captured directly into digital format. The new digital x-ray (DR) imaging technology, similar to digital photography, provides immediate image review and better image quality along with many advantages of electronic image distribution and storage. It requires 30 - 50% less radiation dose than conventional film based radiographic methods. The new technology saves time and money by eliminating waiting periods and saves costs on film processing logistics. Several types of radiography and fluoroscopy are available to image the anatomy and function of a wide variety of organs and bones.

Tele-Radiology

The x-ray images can be quickly transmitted on a number of special diagnostic reading monitors and the images themselves can be analyzed by computer, viewed at distant settings - The digital images are stored on a bank of servers and printed for a high resolution image of the digital x-ray on paper for hard copies. Special picture archiving technology also allows the practice to display and store MRJ images on the same viewing network.

Future Potential

Over the next ten to fifteen years a large majority of conventional (basic) x-ray systems will also be upgraded to all digital technology. In addition to digital fluoroscopic systems (described above), eventually, the majority of film cassette/film screen systems will be replaced by digital x-ray detectors. This technology is currently very new and is now available at a handful of sites worldwide. An intermediate step called phosphor plate technology is currently available at hundreds of sites around the world. These plates trap the x-ray energy and require an intermediate processing step to release the stored information so it can be converted into a digital picture.

Benefits of digital technology to all x-ray systems include:

- Lower dosage x-rays can often be used to achieve the same high quality picture as with film
- Digital x-ray images can be: enhanced and manipulated with computers and sent via a network to other workstations and computer monitors so that many people can share the information and assist in the diagnosis
- Digital images can be archived onto compact optical disks or digital tape drives saving tremendously on storage space and man power needed for a traditional x-ray film library
- Digital images may be retrieved from an electronic archive for future reference

Some modalities like mammography require extremely high resolution film to show the small breast cancers and calcifications. Digital detectors capable of a similarly high resolution are under development and will hopefully be available in the future. However, digital imaging is already being used in parallel to high resolution film in breast imaging and breast biopsy systems.

END NOTE

Author Information

Dr. P Shah Navas, Convener, Research Cell,
Kerala State, IMA. TC 7/171, Kumaran Asan Nagar,
Ulloor, MCPO, Trivandrum - 695011.
Phone: 9447169693. Email: drshahnavas@gmail.com

Conflict of Interest: None declared

Cite this article as: P Shah Navas. Radiography of Bone. Kerala Medical Journal. 2008 Dec 30;1(2):71-74

REFERENCES

1. Tina Di Marcantonio, Orthopedics Today 2006; 26: I
2. Christian R. Krestan et al, MDCT Versus Digital Radiography, Physics Today. June 1997. AJR.05.0478 AJR 2006; 186:1754- 1760
3. Spinasanta.S , Medical Writer, SpineUniverse.com, Desert Hot Springs, CA, X Rays June 2005
4. Foley.K.T, Virtual Fluoroscopy. SpineVniverse.com. June 2005
5. Malanga.G, Diagnostic Tools: X-Ray, SpineVniverse.com, July 2007
6. Radiology information Resource for Patients - web site, ACR. RSNA, June 2005
7. ACR practice guideline for diagnostic reference levels in Medical x-ray imaging, 256, 2002.
8. The International Society of paediatric Oncology - 37th Congress, Vancouver; British Columbia, Canada. September 20-24, 2005
9. Imaginis.com- The Women's Health Resource, May 2007
10. www.expresshealthcare.in - Bhargava.V, Digital Technology in X-Rays, July 2007.
11. Calarco.J, An Historical Overview of the Discovery of the X-Ray, Yale-New Haven Teachers Institute, 2008
12. The Wikipedia - The Free Internet Encyclopedia