

C41-The Evolution of Shielding and Radiation Protection

Objectives

Describe radiation protection/safety in the past and present

Identify when shielding is more vulnerable in specific populations (children/pregnant women) during exams

Define the importance of ALARA

Identify when shielding poses a greater risk

Early Use of Radiation Prior to Radiation Safety

Once x-rays were discovered, there was initially very little concern for safety for the patient OR the technologists.

- Early signs of radiation exposure showed signs of skin reddening, tissue shedding, hair loss, blood disorders, nausea and fever (Sherer et al, 2022).

In 2010, a study demonstrating the findings of early radiation doses using equipment from that time period. Schusser (2021) noted that a Dutch radiologist named Gerrit Kemerink took an x-ray of a cadaver hand using an x-ray machine from 1896. The dose was recorded at 75 mSv; That is 1,500 times the dose of a similar exam done with modern equipment.

“Things slowly began to change between 1900 and 1910, when the carefree use of x-rays began to claim its first victims. The skin damage often began to develop into cancer, bringing the lives of many pioneers in radiology to a premature end.” (Schusser, 2021).

Fig. 1 (Below), shows the progression of lesions caused by continued exposure to radiation



Early Research into Radiation Protection

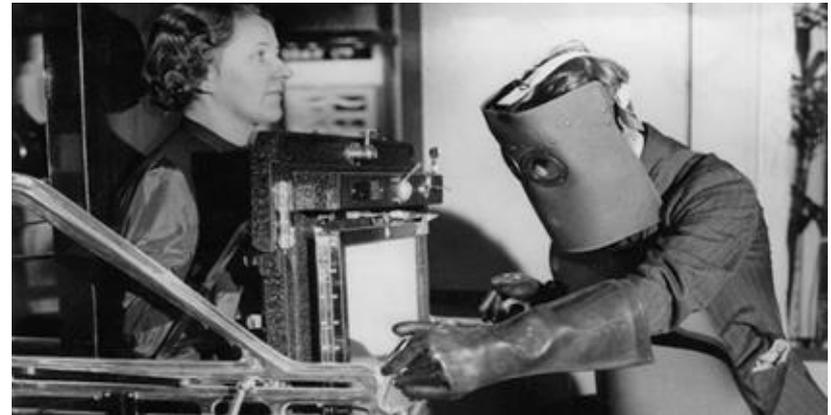
In the years following the discovery of x-rays, it became clear that the dangers of radiation exposure required some modification to how x-rays were performed.

“As early as December 1896, Wolfram Conrad Fuchs in Chicago, recommended x-ray exposures be kept as short as possible, not placing the x-ray tube closer to the body than 30 cm, and rubbing the skin with petroleum jelly prior to exposure.” (Boice et al, 2020).

According to Boice et al (2020), some years later In 1907, a Boston dentist named William Rollins performed a number of x-ray experiments on animals, and concluded that radiation not only did surface damage, but also caused harm within the bodies. Due to his conclusions, he came up with several ideas such as...

- Lead lined glasses and shields
- Protective housing and collimation on X-ray tubes
- Filtration
- Pulsed Fluoroscopy

Fig. 2 (Below) shows early use of lead shielding and mask for an occupational worker during an exam



Modern Century Radiation Protection

Through the 1900's, efforts to improve radiation safety continued.

By the late 1900's and early 2000's technical factors were lower and x-ray equipment became more efficient and accurate (LaBan, n.d).

Shielding included lead aprons, gonadal shields, and thyroid collars, and were used for patients, and occupational workers. Dosimeters also served as a way to monitor radiation workers' exposure doses. (Boice et al, 2020)

In an article written by a radiation physics consultant, Dr. Johnny LaBan, he notes the use of lead aprons to attenuate the ionized photons and protect the body from damage.

“...the lead apron has evolved considerably in the past century.

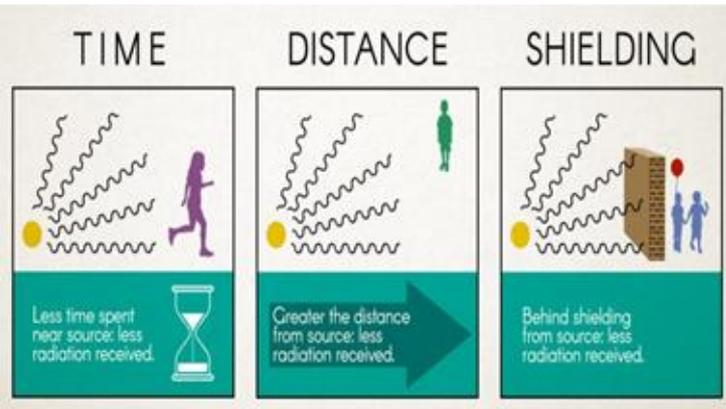
Regardless of the construction particulars, all aprons rely on the same radiation interaction mechanisms to achieve their attenuation abilities, and these mechanisms require the use of high atomic number elements.” (LaBan, n.d.)

Fig. 3 (Below) Evolution of shielding in radiography over the past century



As Low As Reasonably Achievable – ALARA

ALARA is a term used often in Radiology. It stands to protect patients and technologist who are exposed to radiation. ALARA stands for As Low As Reasonably Achievable. ALARA uses three different protective measures including, time, distance and shielding.



When exposed to radiation, technologist want to decrease the amount of time the patient is exposed. Technologist can decrease time, by using Automatic Exposure Control (AEC) during exams. AEC allows the patient get a sufficient amount of radiation to get the image needed.

When exposed to radiation, technologist want to maximize distance from the source of radiation. Which in the case of X-ray would be the x ray tube. Since secondary radiation, also known as scatter, comes from the patient. It is best for the technologist to increase their distance from the patient as much as possible.

When exposed to radiation, technologist may want to utilize shielding. In some cases shielding has been proven to do more harm than good. While studies have shown that, shielding is still practiced in the field to this day. A lead vest is an example of shielding that can be used by the technologist on portable x-rays and also provided to patients.

Shielding can only be used to cover anatomy that is not being imaged

When Does Shielding Pose A Greater Risk?

Shielding in radiology has been an ongoing research topic that has changed over the years. It is used to decrease the dose received by the patient. Although shielding is important, it should never be used in place of other dose reducing principles. Shielding can be used in addition to appropriate collimation size, AEC, and correct positioning.

According to Wolfman (2024), “fetal and gonadal shielding provide no benefit to the patient’s health” (p.11).

Although all areas of the body are important to protect against radiation, the reproductive organs are considered the most important. Shielding is not commonly seen today, but some X-ray technologist will place a lead shield over the reproductive organs.

When Does Shielding Pose A Greater Risk?

While shielding sounds protective, in many exams shielding could cause repeats, which would result in an increased dose to the patient. When shielding interferes with the field of view, it may cut out important anatomy.

Although shielding is not used routinely in exams, patients are still able to request it. While the technologist should educate the patient on the benefit versus risk, it is still the patient's right to have access to shielding.



According to Cincinnati Children's Hospital Medical Center Radiology (2023), shielding does not decrease the internal scatter that happens in pediatrics. This results in the internal organs not being efficiently protected.

Conclusion

Radiation protection has evolved from early, unregulated X-ray use to modern, evidence-based practices focused on minimizing patient and occupational exposure. While shielding was once widely used, current research shows that routine shielding may offer limited benefits and can increase patient dose.

The principle of ALARA (As Low As Reasonably Achievable) remains the foundation of radiation safety, emphasizing optimized exposure through proper collimation, positioning, distance, and technology. By following current guidelines and educating patients on benefit versus risk, imaging professionals ensure safe and effective radiation practices.

Reference Page

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