

**The Use of Medical
Imaging in
Forensic Science**

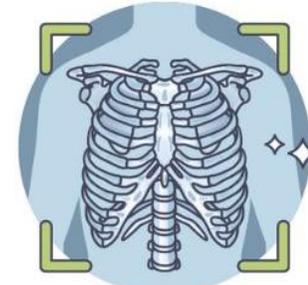
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Objectives

- Define medical imaging and forensic science
- Identify the major medical imaging modalities used in forensic science
- Explain how each imaging modality is used in forensic investigation
- Discuss the advantages and drawbacks of medical imaging in forensic investigations

What is medical imaging?

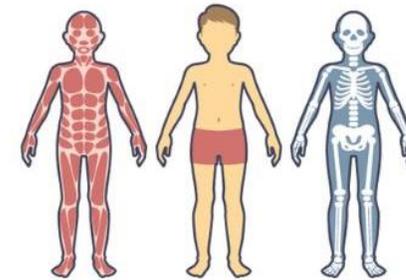
Medical imaging refers to a collection of different technologies designed to visualize the human body to diagnose, monitor, or treat medical conditions. Each imaging method provides specific information about the area of the body being studied or treated, related to possible disease, injury, or effectiveness of medical treatment (Food and Drug Administration, 2018).



X-Ray



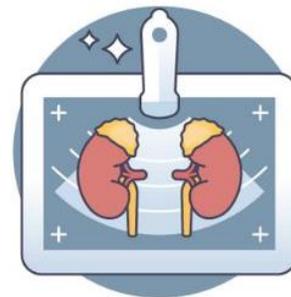
PET Scan



MEDICAL IMAGING TECHNIQUES



CT Scan



Ultrasound



MRI

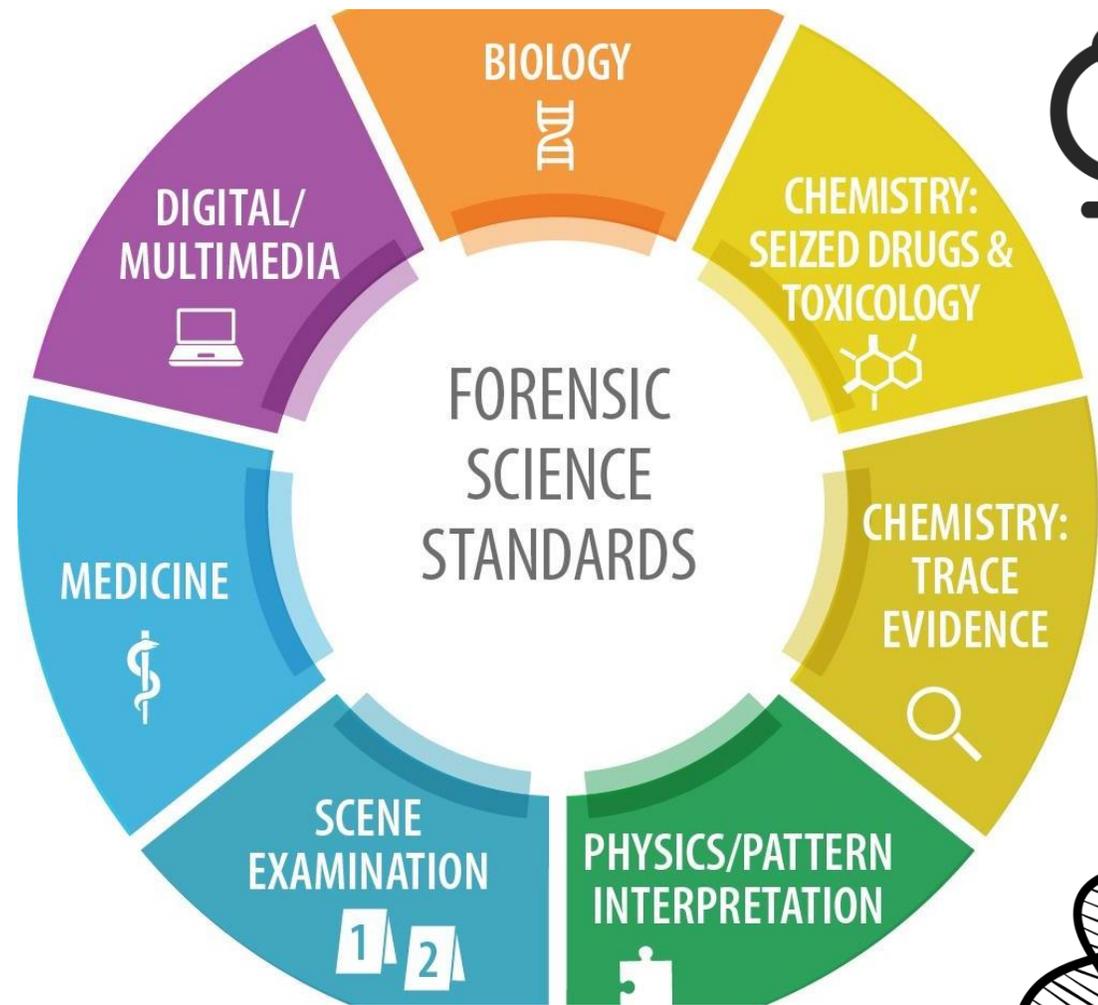
What is forensic science?



Forensic science is the application of law and scientific principles or methods.

It is used to analyze physical evidence for legal, criminal, and civil investigations.

Goal is to provide objective analysis of evidence in crime scenes to help identify suspects and victims, establish timelines, and gain an understanding of circumstances surrounding a crime (Shen, 2016).

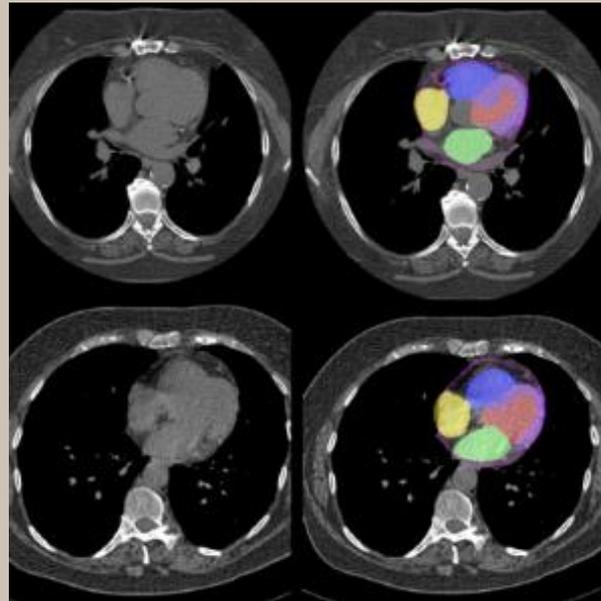


Imaging Modalities Used in Forensics

X-ray



Computed Tomography (CT)



Magnetic Resonance Imaging (MRI)



Ultrasound



X-ray

WHAT IS X-RAY?

An x-ray is a, non-invasive, medical imaging test that uses ionizing radiation to produce a black and white, two-dimensional, image of the body's structures (Tarakanov, 2024).

As radiation goes through the body, soft tissues, bones, and other structures absorb radiation differently creating an image with different shades of gray.

- Solid/dense structures such as bones or tumors appear white on the image.

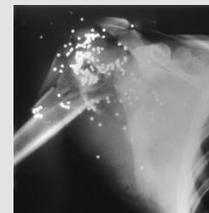
- Soft tissues like muscles and organs do not absorb radiation as easily therefore they appear as different shades of gray.

HOW IS IT HELPFUL IN FORENSIC SCIENCE?

X-rays are one of the most widely used analytical tool in forensics (Tarakanov, 2024).

Used for:

1. Location of foreign objects – ex: bullet fragments inside body
2. Visualizing fractures or other injuries – provides an idea for cause of death
3. Identification - antemortem x-rays compared to postmortem dental or bony radiographs



← Shoulder x-ray demonstrating shotgun injury

<https://pubs.rsna.org/doi/abs/10.1148/radiographics.19.5.g99se171358>

Magnetic Resonance Imaging (MRI)

WHAT IS MRI?

A magnetic resonance imaging, or MRI, is a scan that creates 3D images of structures inside the body using a larger magnet, radio waves, and a computer. This type of scan does not use x-ray radiation (Ruder, 2014).

MRI is ideal for imaging of the brain, nervous system, spine, and cardiac imaging.

MRI safety is important since the machine's magnetic field is always on. This poses a risk for metallic device malfunctions.

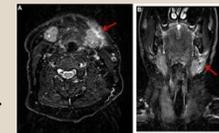
- Caution with implants, jewelry, electronics, certain makeup cosmetics, clothes, prosthesis, etc.



HOW IS IT HELPFUL IN FORENSIC SCIENCE?

MRI is often paired with CT to perform virtual autopsy.

1. MRI provides superior visualization of soft tissue, aneurysms of cerebral vessels, conditions of eyes and inner ear, spinal cord conditions, strokes, tumors, and brain injury traumas - ex: hemorrhages around neck may indicated strangulation)



strangulation victim →

https://www.researchgate.net/figure/MRI-of-a-victim-who-survived-strangulation-1-day-after-the-aggression-in-order-to_fig6_298725645

2. Pediatric/ infant death investigation or abuse— (ex: spinal injuries may indicate shaken baby syndrome, repetitive injuries)
3. Detection of fluid and gas within vessels or organs – identify hematomas, edema, gas within vessels or organs (Ruder, 2014)

Ultrasound



WHAT IS ULTRASOUND?

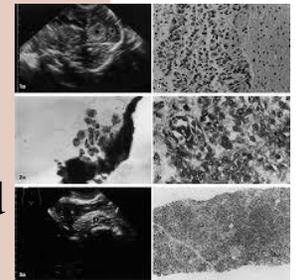
Ultrasound, also called sonography, is an imaging test that shows structures in the body using high-intensity sound waves to create real-time pictures or videos of internal organs or other soft tissues.

During an ultrasound exam, a sonographer will apply a thin layer of gel to skin which allows ultrasound waves to be transmitted from a device called transducer through the gel and into the body. The transducer converts electrical current into waves that are sent into the body's tissue. The soundwaves bounce off the structures and back to the transducer. Waves are then converted into electrical signals. A computer takes the signal and converts it to real time image or video (*Ultrasound: What It Is, Purpose, Procedure & Results, 2022*).

HOW IS IT HELPFUL IN FORENSIC SCIENCE?

Echopsy is a minimally invasive ultrasonographic autopsy. During this procedure, a needle technique is used to obtain tissue samples for post-mortem examinations. This method is good when dealing with infectious diseases (Fariña, 2002).

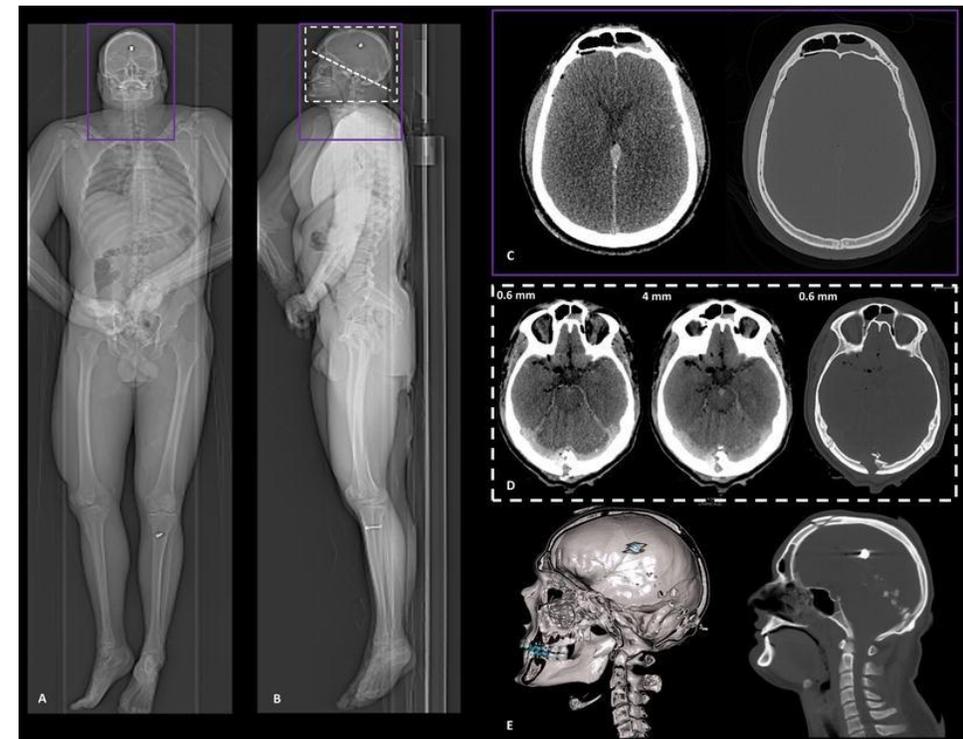
- Provides precise sampling of organs and tissues
- Effective in determining cause of death
- Conventional form of autopsy in cases where family members do not give their consent to classical autopsy



<https://link.springer.com/article/10.1007/s00428-002-0607-z>

Advantages of Medical Imaging in Forensics

- Medical imaging has a variety of modalities that are non-invasive. This allows for virtual autopsies that do not damage the body nor alters evidence in comparison to traditional autopsy which involves dissection. Virtual autopsies respect certain cultural and religious beliefs.
- Most of the imaging exams produce results in minutes such as x-rays and ultrasounds. These two imaging modalities can also be done portably which allows for on site investigations.
- The use of imaging protects staff from potential infectious pathogens due to minimal handling of body.
- Digital imaging serves as superior documentation. It provides permanent records that can be reviewed and shared. 2D and 3D images are also less disturbing but still serve as acceptable evidence in legal proceedings.
- Aids in the process of accurate trauma analysis with the interpretation of fractures, wounds, pathology, etc.
- New opportunities for imaging professionals.



Postmortem Imaging

Challenges of Medical Imaging in Forensics

1. The use, maintenance, and interpretation of medical imaging comes at a high cost. High cost, specially of CT and MRI, limits access to these technologies.

2. Decomposition of body may result in low quality images or misinterpretation of pathology. Ex: postmortem bodies have lower body temperature which absorbs radiation differently.

Hotter bodies absorbs more x-rays radiation creating optimal images.

3. Ethical debate encompassing privacy with legal requirements.

4. There is a lack of forensic radiology training, few clinical guidance or protocols established in most medical clinics/hospitals.

(Alafer, 2025)

Teamwork Outlook

Imaging technicians work in collaboration with forensic pathologist.

Forensic pathologist: a specialized medical doctor who determines the cause and manner of death in cases that are sudden, unexpected, violent, or suspicious.

- Perform autopsies, document injuries, provide expert testimony in court (*Forensic pathologist, 2025*).

Imaging technicians must be trained in forensic radiology to distinguish between antemortem and postmortem artifacts.

Imaging technician responsibilities:

- Create 3D reconstructions
- Operate medical equipment
- Help identify trauma and anatomy

Conclusion



Medical imaging serves as a valuable tool in the field of forensic science.



Common imaging modalities used in forensics are x-rays, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound.



Together, these modalities provide non-invasive examinations that assists in determining cause of death, identify individuals and foreign objects, evaluate trauma or signs of abuse, and supports crime scene investigations.



Although medical imaging offers advantages such as quick results, portable equipment, and expanded career opportunities for imaging professionals, it also present challenges, including ethical issues and high costs.

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