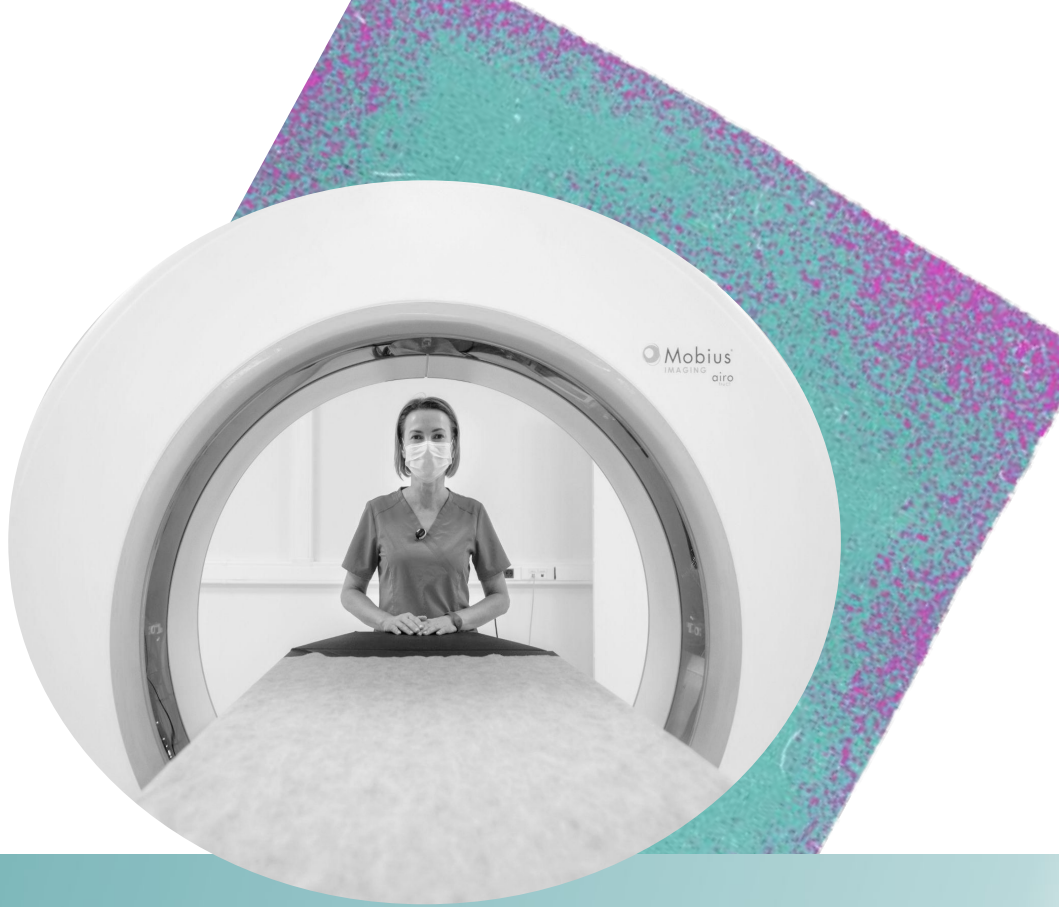
Lesson 3: Exploring The Inside Story

How MRI Helps Doctors See Inside Your Body



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MRI Marvels

Your Journey into Biomedical Engineering

Review

L2: Inside the Scanner

- Lesson 2 took us on a journey through the vital components of an MRI machine, highlighting the main magnet's role in creating a uniform magnetic field.
- We delved into different types of magnets like superconducting magnets, the function of gradient coils in encoding signals, and the crucial part RF coils play in interacting with hydrogen nuclei.
- These insights help us to appreciate the complexity and innovation in MRI technology, understand how it works, and why it's an essential tool in modern medical imaging.

Doctor Spotlight

Dr. John Mallard was a medical physicist known for leading the team that built the first full-body MRI scanner at the University of Aberdeen in the 1970s. His work laid the foundation for the use of MRI in modern healthcare.

What Did He Do?

- On August 28th 1980, Mallard's group used this machine to obtain the first clinically useful full-body image of a patient's internal tissues using MRI
- This work transformed the field by helping to take MRI from small scans to full-body scanning

John Mallard

Image form: https://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-56217687

Lesson Objective

In this lesson we will explore how MRI is used by doctors to image the body and diagnose various conditions.

By the end of this **lesson**, you will learn:

- What MRI can be used to diagnose
- How MRI helps doctors diagnose diseases
- How biomedical engineering can help doctors better treat patients

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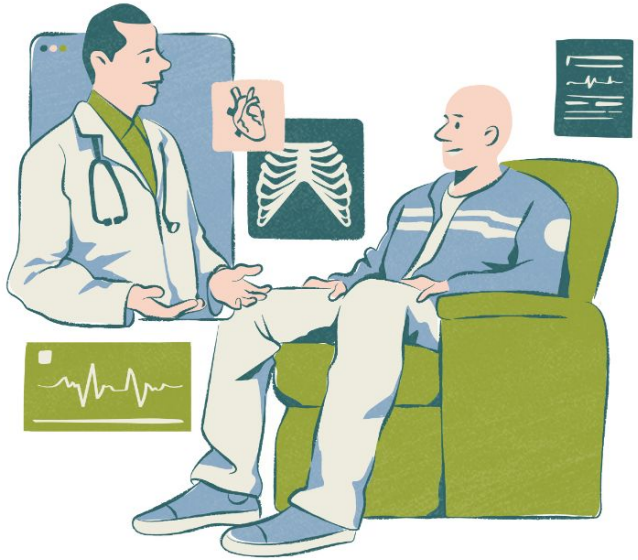
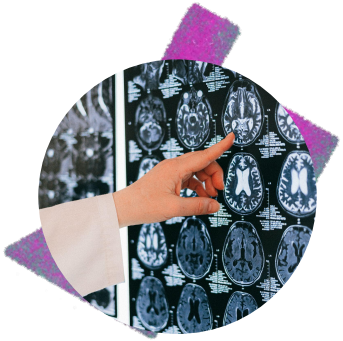
MRI in Modern Medicine

MRI is a **non-invasive imaging** tool that allows doctors to see inside a patient's body without surgery or needles. This tool has revolutionized healthcare, allowing doctors to **precisely detect various medication conditions**.

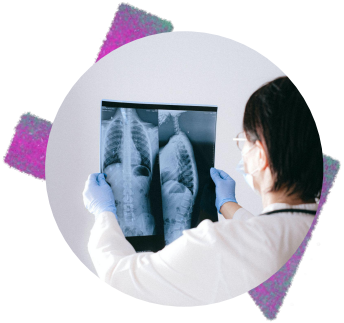


MRI in Modern Medicine

In this lesson we'll explore several areas that MRIs are used in medicine



Brain Imaging



Musculoskeletal Imaging

Cardiac Imaging

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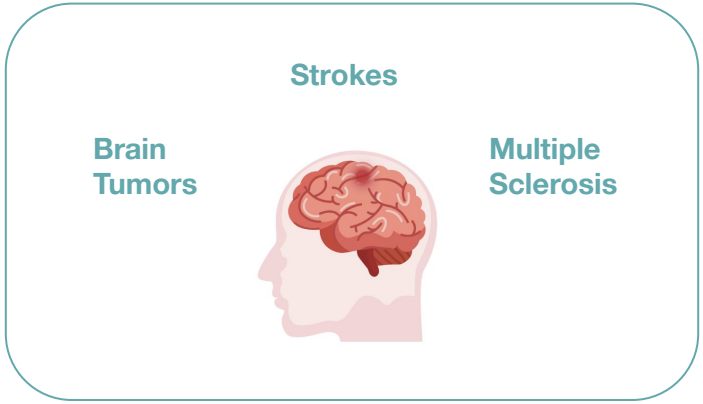
MRI for Brain Imaging

Think of MRI like a **detective's magnifying glass**, allowing doctors to zoom in to discover hidden clues within the brain that may reveal diseases or injuries.

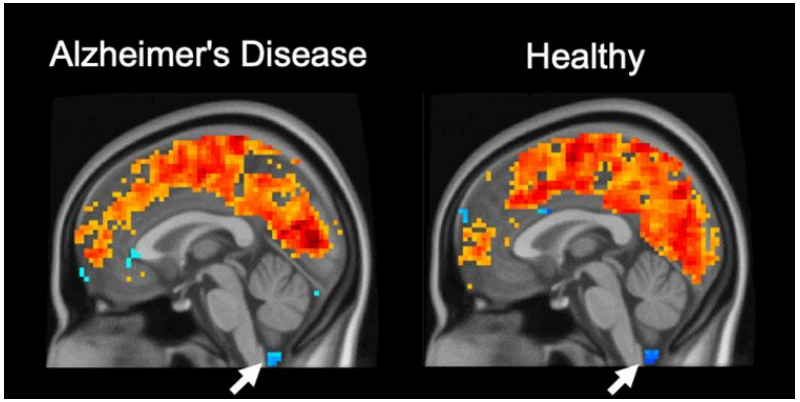
MRI can help doctors spot



MRI for Brain Imaging

There's even a special type of MRI called **functional MRI (fMRI)**. This tool can estimate the brain's activity by measuring blood flow.

fMRI can help doctors identify what parts of the brain are responsible for different functions like speech or movement. This helps doctors better understand how diseases like Alzheimer's disease impact the brain.



Like a Movie in the Brain🎥

fMRI takes multiple images quickly, showing the brain in action. This allows doctors to watch your brain activity like a movie!

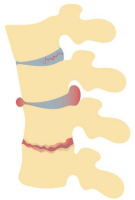
MRI for Musculoskeletal Imaging

MRI in Musculoskeletal Imaging is similar to an advanced X-ray for the body's structure, focusing on bones, joints, and soft tissues, but with much more detail.

MRI can help doctors spot

Torn ligaments

Herniated disks



Torn ligaments

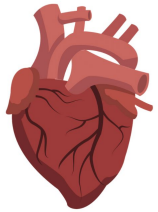
MRI for Cardiac Imaging

Cardiac MRIs are like that camera for the heart, which provides insights into how the heart muscles are working, how blood is flowing, and if there are any blockages or abnormalities.

MRI can help doctors spot

Holes

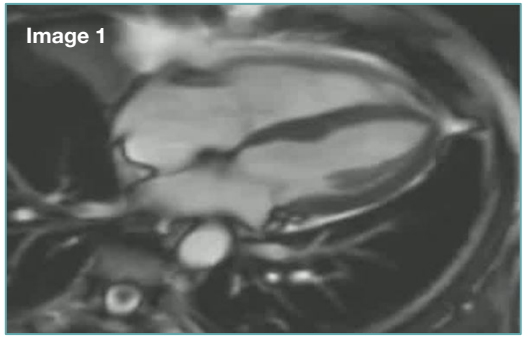
Abnormal connections



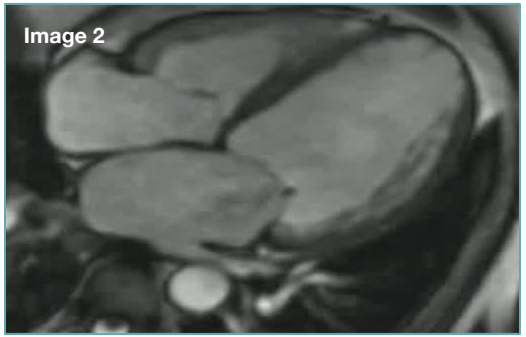
Blood flow

MRI for Cardiac Imaging

Let's take a closer look at the heart using MRI images.



This first image shows a healthy heart. You can see how the chambers and vessels are well-shaped, and the blood flow appears smooth. This image represents a heart that's working just as it should, pumping blood efficiently to all parts of the body.



Now, let's look at this second image. Can you spot the difference? Here we see a defect. Notice the unusual shape and the blood pumping in an abnormal way compared to the first image. This defect can make the heart work harder, causing problems if left untreated.

MRI in Modern Medicine

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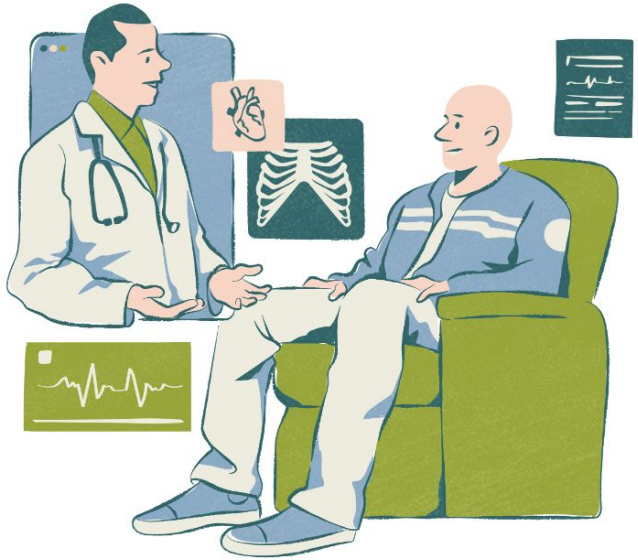
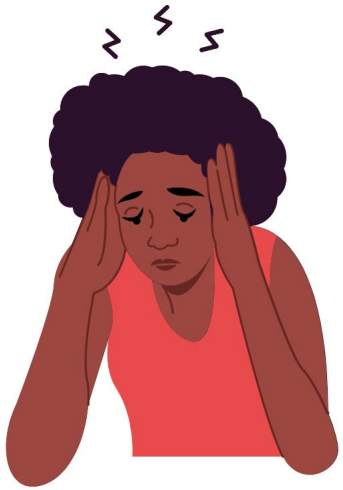
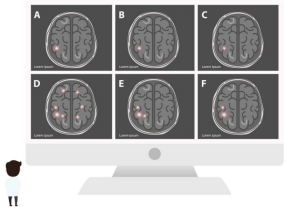


Case Study
Head Trauma





- A 47 year old woman hit her head. She experienced headaches and problems with focus and attention for five weeks.
- The doctors performed a special scan of her brain using fMRI. This showed that the blood was not flowing properly in her brain
- **By using fMRI the doctors were able to understand what was going on in her brain and help her recover**

Class Activity

Group Exploration: Divide into small groups of 3-4 Students.

Distribute Cases: Provide each group with a hypothetical medical case

Discuss Brainstorm:

- What could be causing the symptoms?
- How could you use an MRI to help better understand the problem?
- What information would the MRI provide?

Present Findings: Share your ideas with the class in a short presentation!

Images from: pexels.com/cottonbrostudio

Case Study #1

Persistent Knee Pain

GROUP EXERCISE

- The Problem: Tim, a middle school basketball player, has persistent knee pain that worsens with activity. Physical therapy hasn't helped.

  What could be the underlying issue?

Case Study #2

Chronic Back Pain

GROUP EXERCISE

- The Problem: Emily, an avid dancer, experiences chronic back pain. It's affecting her daily life, but regular examinations have shown no clear cause.

  What could be behind this pain?

Case Study #3

Frequent Seizures

GROUP EXERCISE

- **The Problem:** Michael, an otherwise healthy student, has started experiencing frequent seizures. Neurological evaluations have not identified a clear cause.

  What might be leading to these seizures?

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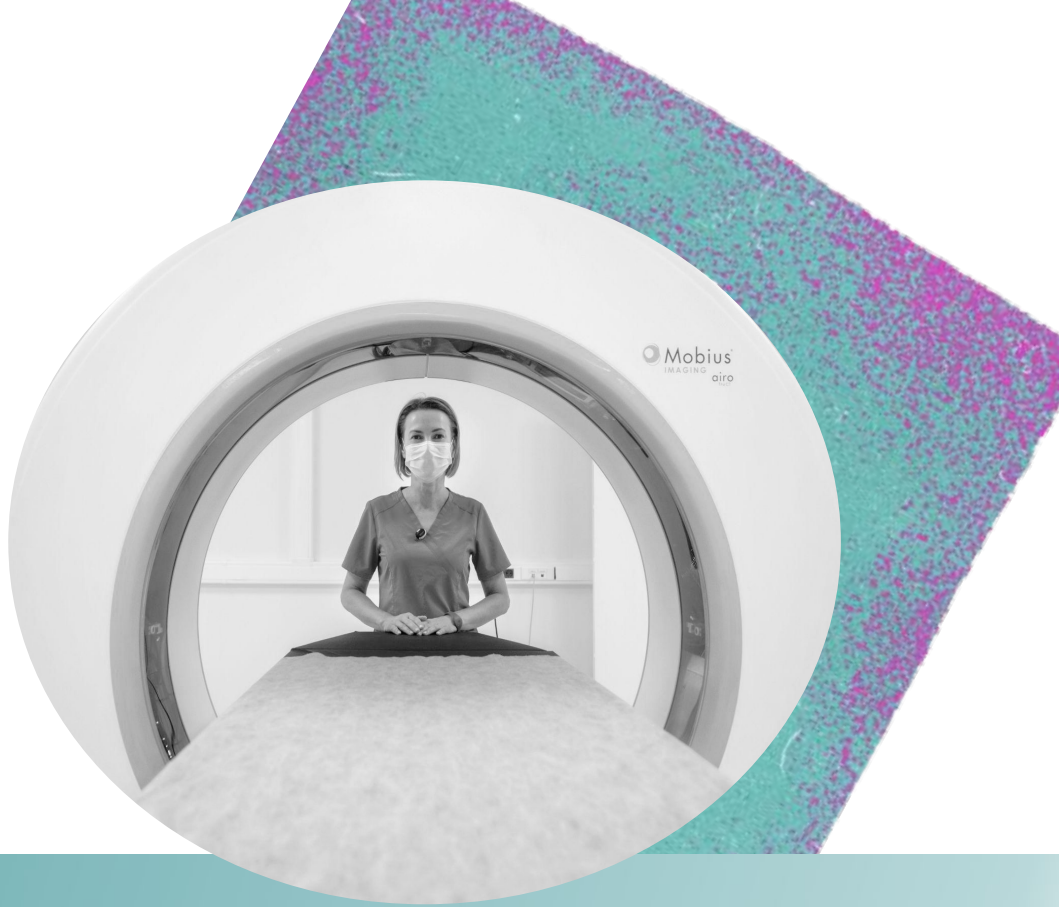

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