SNS COLLEGE OF ALLIED HEALTH SCIENCE

Affiliated to The Tamil Nadu Dr MGR Medical University, Chennai

DEPARTMENT OF RADIOGRAPHY AND IMAGING

TECHNOLOGY

COURSE NAME : EQUIPMENTS OF ADVANCED MODALITIES

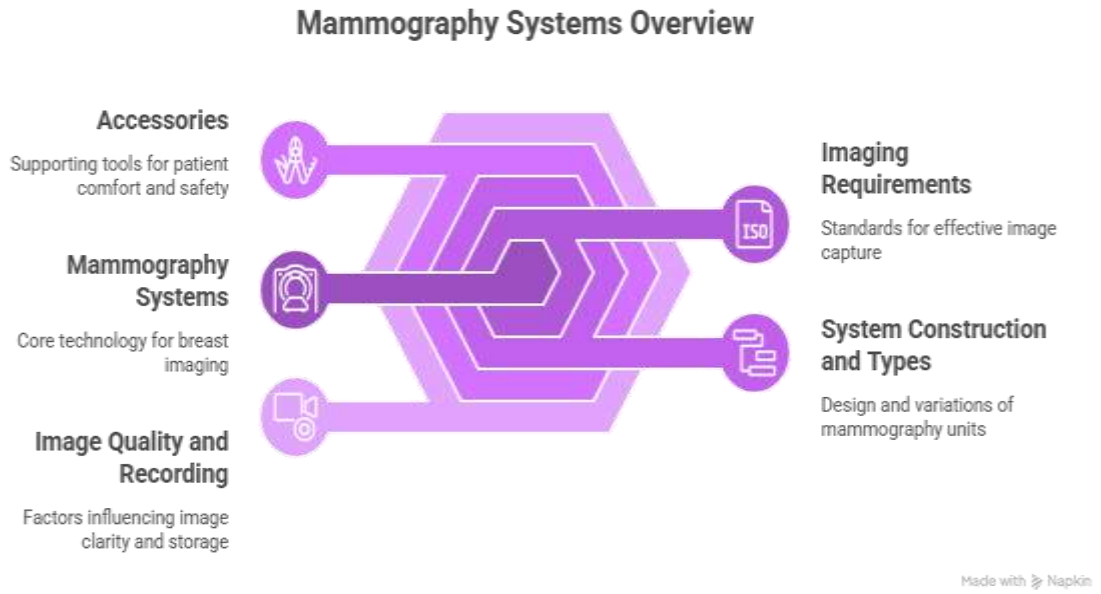
UNIT : MAMMOGRAPHY SYSTEM

TOPIC : HISTORY,CONSTRUCTION,WORKING AND IMAGE QUALITY

FACULTY NAME: MRS.G.HELANA JOY

INTRODUCTION - DEFINE

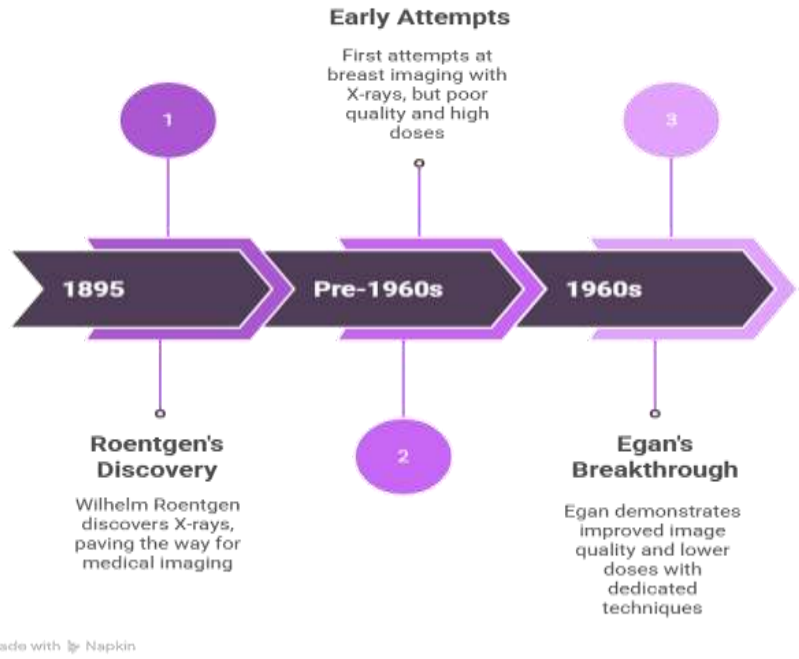
Mammography systems are specialized X-ray units for breast cancer detection, evolving from film-screen to digital imaging with a focus on high-resolution imaging at lower energy levels.



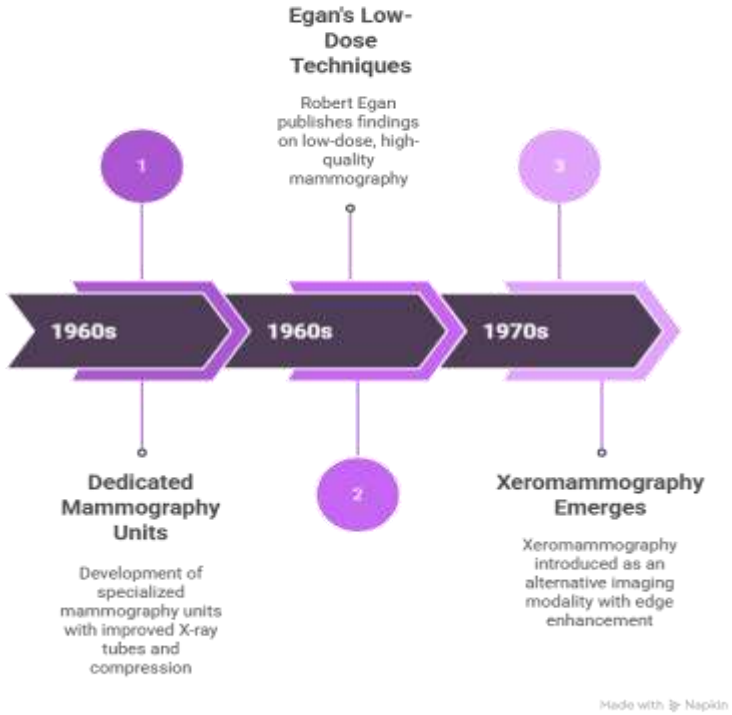
HISTORY

- 1913: Albert Salomon (Germany) – first X-ray images of mastectomy specimens
- 1930s: Stafford Warren – early dedicated mammography using conventional X-ray units
- 1956: Robert Egan – developed standardized technique (low kVp, high mAs, film-screen)
- 1960s: Introduction of molybdenum target & molybdenum filtration
- 1969: Xerox 125 system – first dedicated mammography unit with Mo anode
- 1970s: Screen-film mammography + dedicated units (CGR, GE, Philips)
- 1990s: Full-Field Digital Mammography (FFDM) – FDA approval of first system (GE Senographe 2000D, 2000)
- 2000s–2010s: Digital Breast Tomosynthesis (DBT), Contrast-Enhanced Mammography, CR mammography.

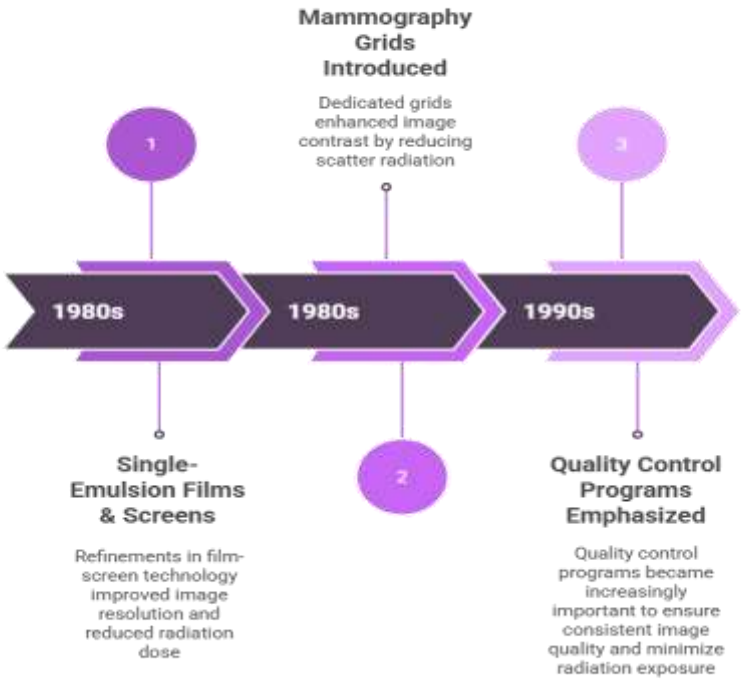
Early Milestones in Mammography History



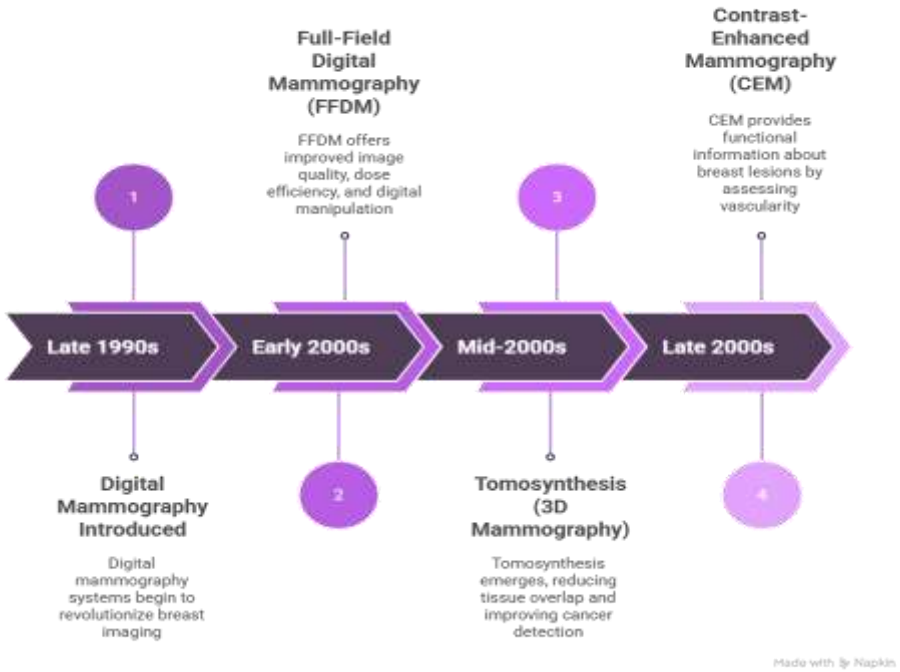
Key Developments in Mammography Systems (1960s-1970s)



Advancements in Film-Screen Mammography (1980s-1990s)

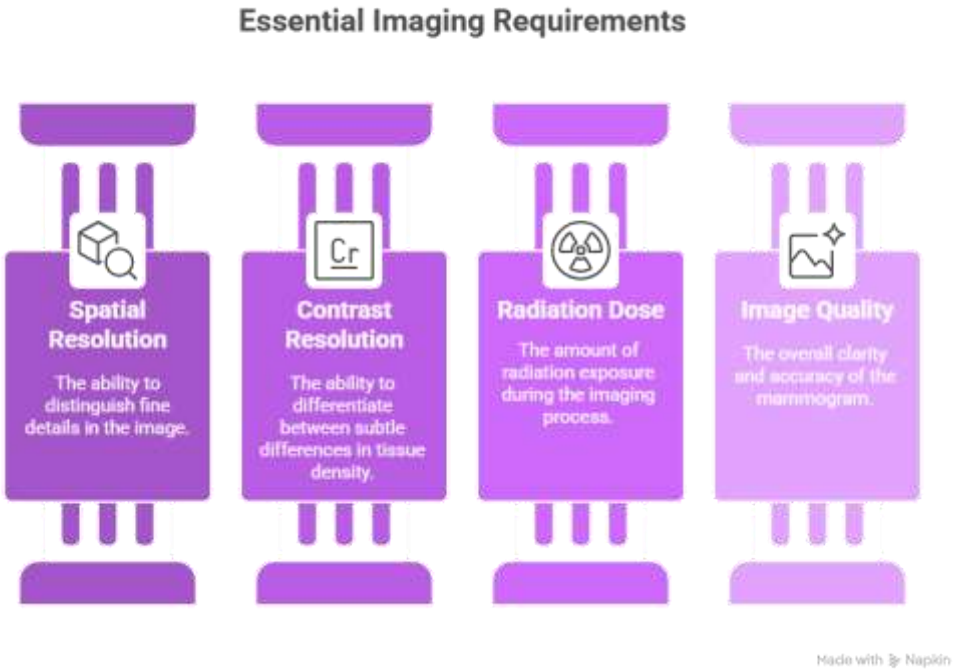


Evolution of Digital Mammography (Late 1990s-Present)



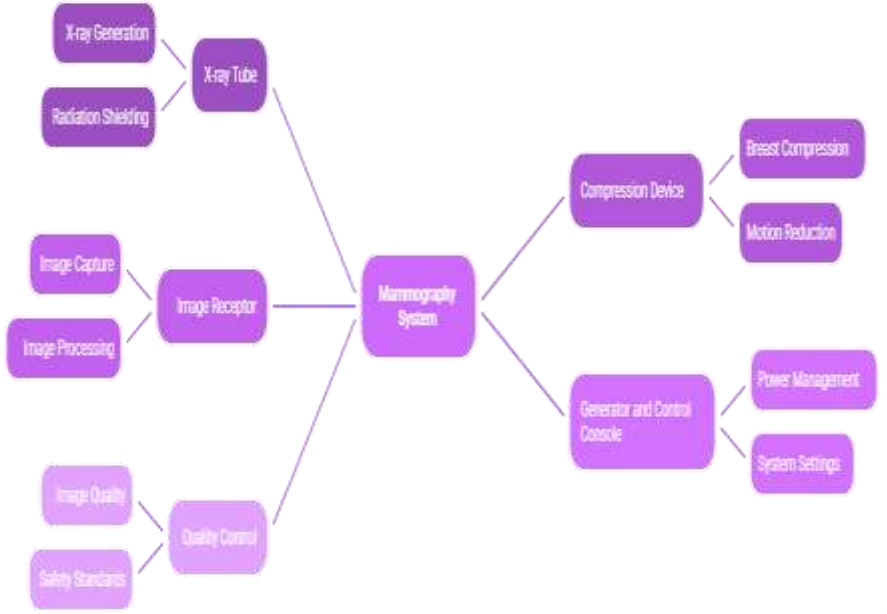
IMAGING REQUIREMENTS

- High sensitivity is required for the detection of small lesions and microcalcifications.
- Consistent low-dose imaging is needed due to breast tissue radiosensitivity.
- High spatial resolution and optimal contrast help visualize soft tissue variations and early-stage cancers.



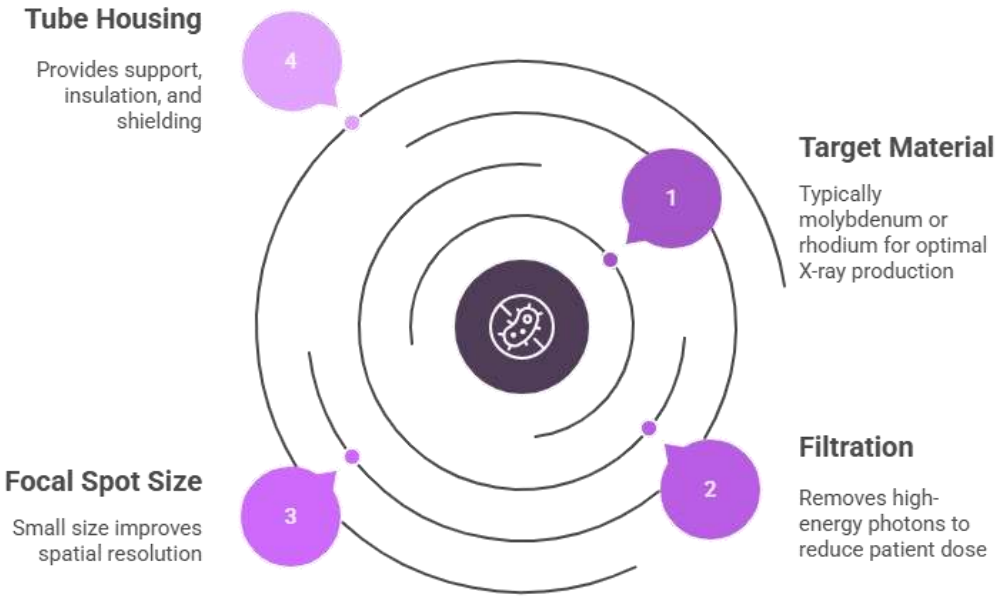
MAMMOGRAPHY SYSTEM: CONSTRUCTION & TYPES

A mammography system is a specialized X-ray imaging system designed specifically for breast imaging. Its construction involves several key components working in concert to produce high-quality images while minimizing radiation exposure.



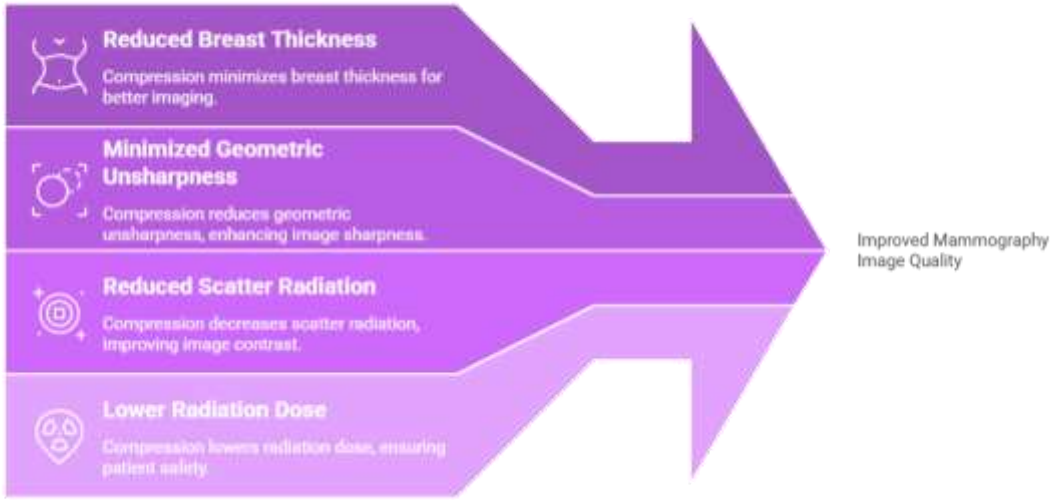
X-RAY TUBE AND BEAM

- Tube usually has molybdenum or rhodium targets, producing low-energy X-rays (22–30 kV).
- Fine focal spot (0.1–0.3 mm) for high-resolution imaging.
- Filters (Mo or Rh) shape the X-ray spectrum for tissue differentiation and dose reduction.



COMPRESSION DEVICE

- Motorized or manually operated compression plates made of polycarbonate and designed to exert 100–200 N.
- Compression:
  - Reduces tissue thickness and scatter.
  - Improves sharpness and contrast.
  - Reduces radiation dose and geometric blur.
  - Immobilizes breast to avoid motion artifacts.

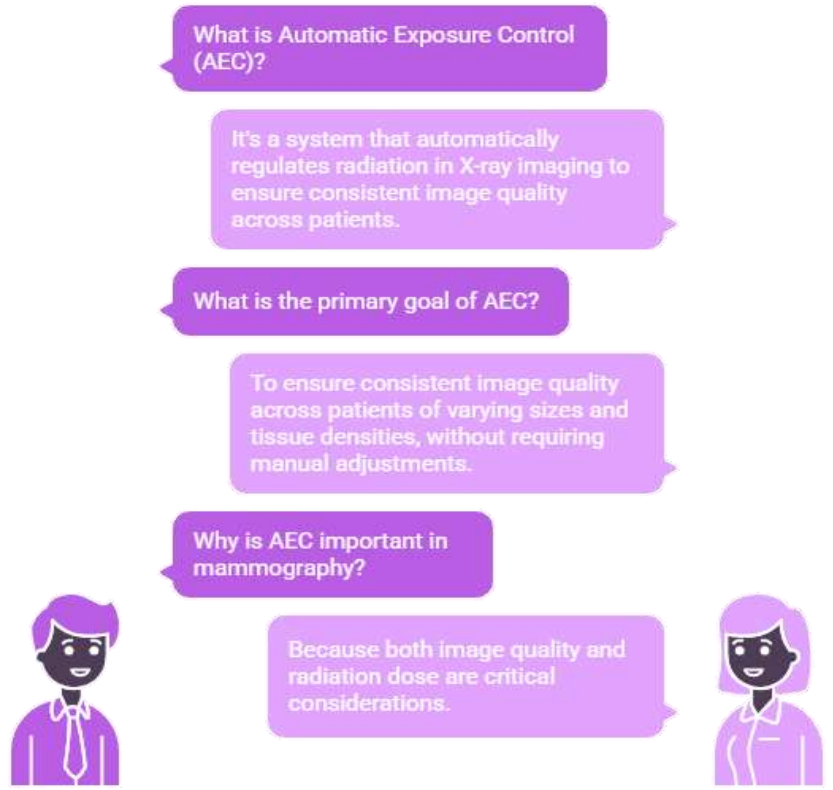


GRIDS

- Anti-scatter (moving) grids are used for standard contact images, not for magnified views.
- Grids improve spatial resolution by reducing scatter; magnification views use an air gap technique instead.

AUTOMATIC EXPOSURE CONTROL (AEC)

- AEC maintains exposure consistency by adjusting technique factors based on breast thickness and composition.
- Modern systems integrate AEC into digital detectors; older screen-film units used separate AEC chambers.



ACCESSORIES FOR IMMOBILIZATION

- Specialized paddles (AST paddles) provide uniform and comfortable compression, improving tissue immobilization and image quality.
- Accessories include cones for localization and radiation protection, and optional biopsy attachments.

FILM PROCESSING & IMAGE RECORDING DEVICES

- Film-screen systems require precise processing: developer temperature, time, and agitation are critical for diagnostic quality.
- Digital systems use flat-panel detectors, direct digital output, and advanced processing algorithms for superior image analysis and archiving.
- Image recording devices include dedicated mammography cassettes for analog systems and high-resolution digital monitors for DR systems.

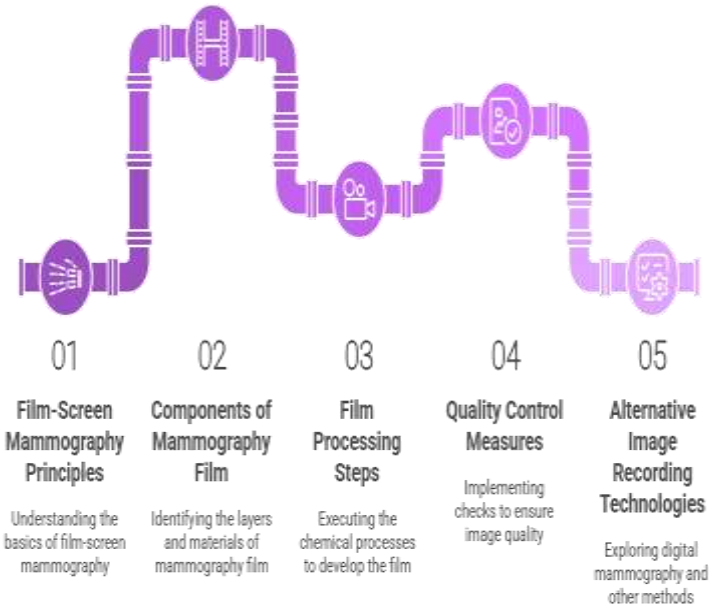
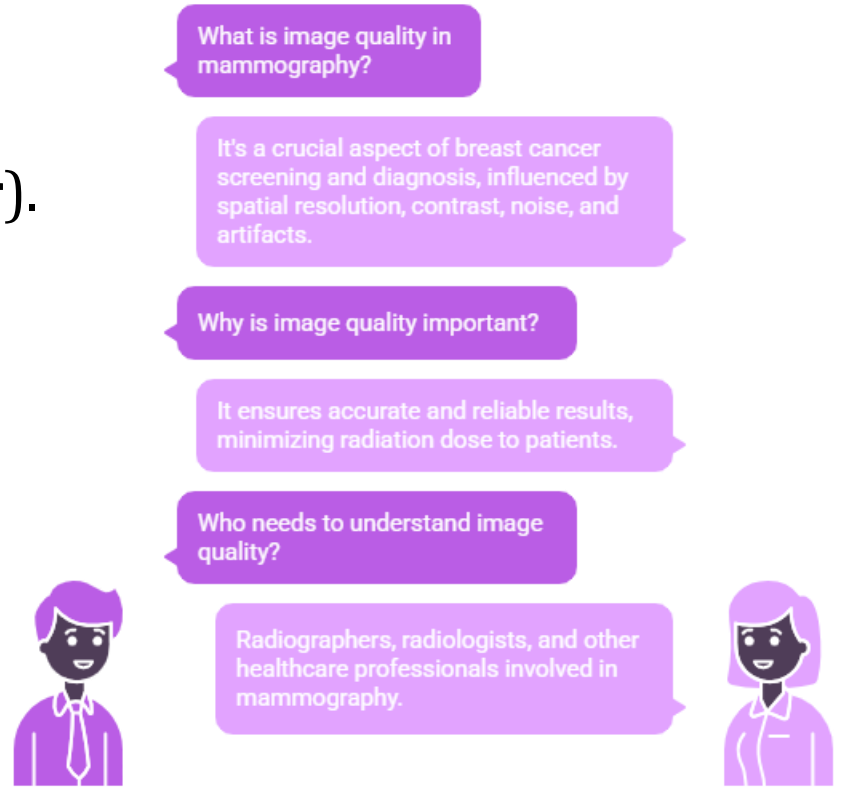


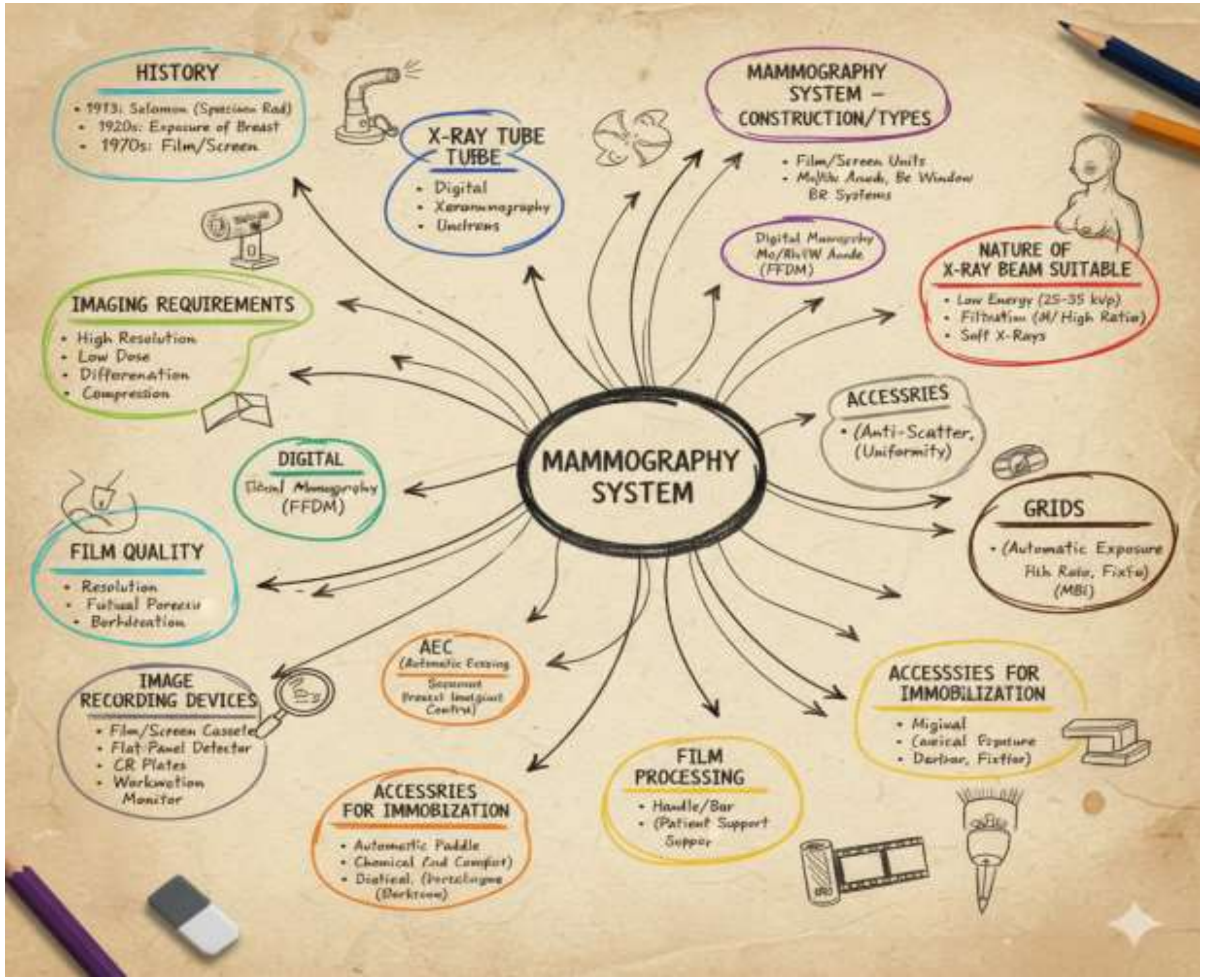
IMAGE QUALITY

Quality depends on:

- Compression (minimizes tissue overlap and motion blur).
- Fine focal spots for increased resolution.
- Use of grids and proper beam energy.
- High-quality detectors (film or digital) and appropriate exposure technique.



SUMMARY



MAMMOGRAPHY SYSTEM
HISTORY
1970s: Film/Screen
X-RAY TUBE
Digital
MAMMOGRAPHY SYSTEM – CONSTRUCTION/TYPES
Film/Screen Units
NATURE OF X-RAY BEAM SUITABLE
Low Energy (25-35 kVp)
Soft X-Rays
IMAGING REQUIREMENTS
High Resolution
Low Dose
Differenation
Compression
ACCESSRIES
(Anti-Scatter, (Uniformity)
DIGITAL
(FFDM)
GRIDS
FILM QUALITY
Resolution
AEC
IMAGE RECORDING DEVICES
Flat-Panel Detector
CR Plates
ACCESSSIES FOR IMMOBILIZATION
FILM PROCESSING
Handle/Bar
ACCESSRIES FOR IMMOBIZATION
Automatic Paddle

References:

- **Mammography Quality Standards Act (MQSA) Regulations.**
- **https://www.radiologycafe.com/frcr-physics-notes/x-ray-imaging/mammography/**
- **https://www.nibib.nih.gov/sites/default/files/2022-05/Fact-Sheet-Mammography.pdf**