The Crushing Truth About Compression

Sarah Jacobs, B.S., R.T.(R)(M)(CT)
Senior Breast Imaging Consultant, Mammography Educators

1

Objectives

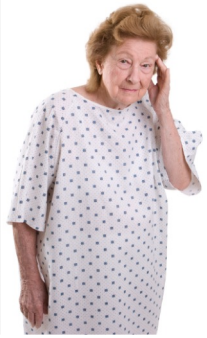
- Identify the goal of compression during mammographic exams and why it's so important
- Distinguish when and how compression should be applied
- Recognize common challenges that may prevent the application of adequate compression
- Use communication tools to aid in achieving adequate compression

2

Mammography Technologists

- Creatures of habit
- Scripts are familiar
- Live and breathe patient care
- Understand our role is personal

3

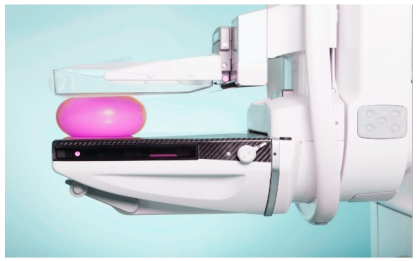


"Please take off everything from the waist up and make sure your gown is open to the front."

4

Noun

com·pres·sion
/kəmˈpreSHən/



1. The act of compressing or being compressed
    a. The reduction in volume

MAMMOGRAPHY EDUCATORS

5

Compression in Mammography

MAMMOGRAPHY EDUCATORS

6

Compression in Mammography

- Pulls breast away from chest wall
- Minimizes motion
- Creates more uniform thickness
- Spreads out overlapping tissues
- Reduces patient radiation dose
- Increases contrast of the image
- Reduces scatter

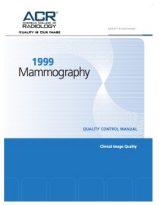
MAMMOGRAPHY EDUCATORS

7

What's Required?

According to the 1999 ACR Manual, ideal compression should be based upon 2 factors:

1. The maximum amount an individual patient's breast can actually be compressed
2. The amount of compression that the patient can tolerate during the exam

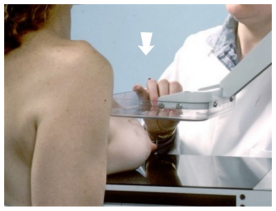


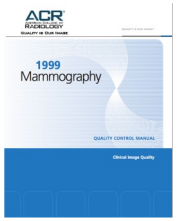
MAMMOGRAPHY EDUCATORS

8

Adjective

taut
/tôt/





"Ideally the breast should be compressed until the tissue is taut: gentle tapping will not indent the skin when breast compression is taut. At a maximum, compression should be less than painful."

MAMMOGRAPHY EDUCATORS

9

European Journal of Radiology
December, 2014

"According to researchers, the lack of consistent guidelines regarding mammographic compression has led to wide variation in it's technical execution."

NCBI
November, 2017

"While it is widely accepted that firm breast compression is needed to ensure acceptable image quality, guidelines remain vague about how much compression should be applied during mammogram acquisition."

MAMMOGRAPHY EDUCATORS

10

A lack of standardization in compression guidelines results in:

- Decreased reproducibility in imaging
- Increased risk of unnecessary pain
- Inadequate image quality

MAMMOGRAPHY EDUCATORS

11

> Properly applied compression is one of the most neglected and most important factors affecting image quality in mammography*.
>
> *Clinical Image Quality section, 1999 ACR Manual

MAMMOGRAPHY EDUCATORS

12

1. Lack of consistent compression guidelines
   - Inadequate image quality, higher recall rates and unnecessary pain for patients
2. Properly applied compression is neglected, even though it's an extremely important factor that affects image quality

MAMMOGRAPHY EDUCATORS

13

3. We know that how much technologists *should* be compressing the breast should be a combination of:
   - How much *TECHS* can actually *reduce the breast's volume*
   - How much the *PATIENT* can actually *tolerate*
4. Techs should compress until the breast is "*taut*" or less than painful

MAMMOGRAPHY EDUCATORS

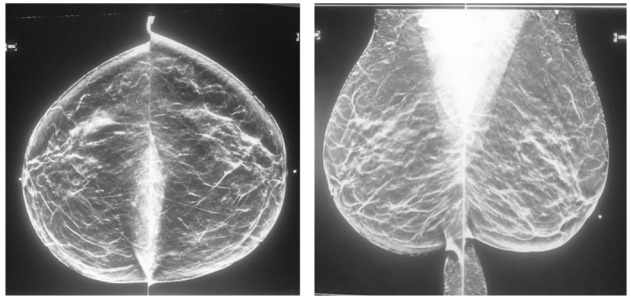
14

Looking for that magical number for compression…?

MAMMOGRAPHY EDUCATORS

15

Consistency in Compression



MAMMOGRAPHY EDUCATORS

16

TABLE 2: Compression Force and Posterior Nipple Line Measurements in 170 Patients in Study Group

Characteristic	FFDM (*n* = 170)	DBT (*n* = 170)
Compression force (N), mean (SD)		
MLO, mean (SD)	22.8 (6.61)	21.4 (6.00)
CC, mean (SD)	19.4 (4.63)	18.8 (5.07)

American Journal of Roentgenology (AJR) December, 2017:
Mammography Positioning Standards in the Digital Era: Is the Status Quo Acceptable?

MAMMOGRAPHY EDUCATORS

17

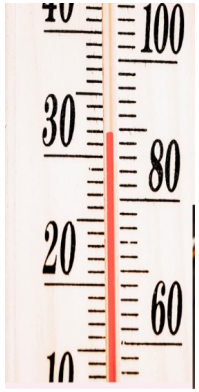
How is Compression Measured?

- daN
- lbs
- N
- kPa

MAMMOGRAPHY EDUCATORS

18

What do these have in common?



MAMMOGRAPHY EDUCATORS

19

How is Compression Measured?

- PSI = Pounds per square inch
  - Pressure is measured in PSI / relates to contact area
- kPa =kilopascal
- N = Newtons
  - 1 newton of force – divide the force value by 4.448 to get amount of force in pounds
- daN = decanewtons
  - (10 daN = 1 Newton)

MAMMOGRAPHY EDUCATORS

20

Compression Force vs. Compression Pressure

Pressure = Force / Contact Area

MAMMOGRAPHY EDUCATORS

21

How is Compression Measured?

Compression force is measured in pounds and daN, for most mammography units.

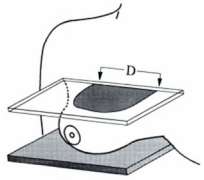


Figure 8-11 **Compression in pounds per square inch** (psi). The actual pressure applied to the breast is the force applied (in pounds) divided by the area over which the force is spread, giving psi. If the breast is assumed to be a hemisphere, then psi equals half the area of a circle whose diameter (D) is that of the part of the breast touched by the compression paddle, divided into the number of pounds applied. This diagram depicts the surface in contact with the compression paddle and film holder. The larger the surface in contact, the lower the pressure in psi.

MAMMOGRAPHY EDUCATORS

Image courtesy *Breast Imaging,Third Edition*, Kopans 2007

22

Compression Force vs. Compression Pressure

- Force = the amount of effort that it takes for the paddle to compress the breast
- Pressure = how much physical force is exerted on the breast

PRESSURE is a "FEELING"
FORCE is an "ACTION"

MAMMOGRAPHY EDUCATORS

23

MAMMOGRAPHY EDUCATORS

24

Compression in Mammography

1. Image quality
2. Cancer detection

MAMMOGRAPHY EDUCATORS

25

Compression and Image Quality

Compression pressure can be related to measures of mammographic performance such as:

- Recall rate
- False positive rate
- Screen-detected cancer rate

MAMMOGRAPHY EDUCATORS

26

Compression and Image Quality

"Inadequate compression played a role in up to 38% of image quality deficiencies."

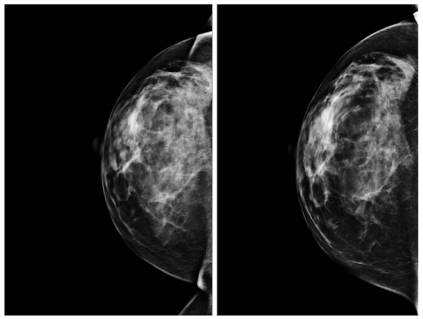
A. Positioning	B. Compression	C. Exposure Level	D. Sharpness
E. Contrast	F. Noise	G. Artifacts	H. Exam Identification

MAMMOGRAPHY EDUCATORS

FDA's MQSA Insights article:
"Compression: Another Critical Factor in Image Quality"

27

Compression and Image Quality



MAMMOGRAPHY EDUCATORS

28

Consistency and Compression

General Rule of thumb: 17% variance in compression

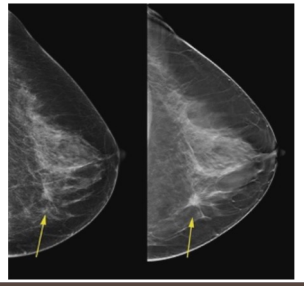
- Reproducibility in mammographic images is just another key to quality and earlier detection

MAMMOGRAPHY EDUCATORS

29

Cancer Detection

Inadequately compressed mammographic exams



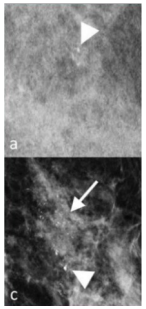
MAMMOGRAPHY EDUCATORS

30

Inadequate Compression

Inadequate compression results in:

- Limited beam penetration
- Increased tissue overlap



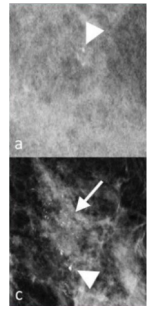
MAMMOGRAPHY EDUCATORS

Images courtesy of: https://cme30.eu/detection-of-subtle-breast-cancers-with-mammography-the-importance-of-using-the-correct-technology-and-technique/

31

Inadequate Compression

Patient motion can blur architectural distortion and microcalcifications. This is particularly true with spot compression and magnification views due to the long exposure times required.



MAMMOGRAPHY EDUCATORS

Images courtesy of: https://cme30.eu/detection-of-subtle-breast-cancers-with-mammography-the-importance-of-using-the-correct-technology-and-technique/

32

The Importance of Anterior Compression

MAMMOGRAPHY EDUCATORS

33

Nipple Areolar Complex

- Approximately 10% of breast cancers
- Vascular tissue / Subareolar complex
- Adequate compression is imperative
- Additional views may be required

MAMMOGRAPHY EDUCATORS

34

"Over-compressing" the breast

Is over-compressing even possible?

Marge, come quick. I think I've won the contest for the highest compression!!

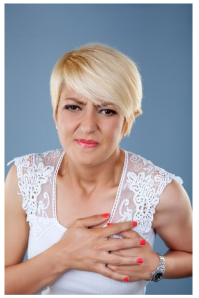
MAMMOGRAPHY EDUCATORS

35

Too much pressure, can actually reduce the **sensitivity*** of mammography.

BMC, Nov 2017: *"Influence of breast compression pressure on the performance of population-based mammography screening"*

*Sensitivity is the probability of finding a cancer in mammography.



MAMMOGRAPHY EDUCATORS

36

Over-compression occurs less frequently in the United States, where under-compression, or extremely low applied pressure, is more common.

MAMMOGRAPHY EDUCATORS

37

How and When Compression Should Be Applied

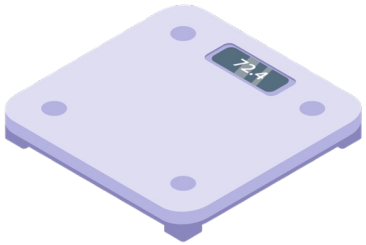
- Ensure your patient is ready
- Compression paddle should take the place of your hand during positioning
- Apply at a speed that ensures your patient is comfortable
- Use a combination of the foot pedal and the manual hand crank
- Override automatic compression release when necessary

MAMMOGRAPHY EDUCATORS

38

Compression Testing

- Quality Control Tests
- Medical Physicist Tests



MAMMOGRAPHY EDUCATORS

39

When to Call for Service

Problems with compression testing and results.

MAMMOGRAPHY EDUCATORS

40

"I wish there was a better way..."

Great news! We're getting there!

MAMMOGRAPHY EDUCATORS

41

Progress

The FDA has cleared for U.S. marketing many devices, accessories, or features which may lessen the discomfort of breast compression.

MAMMOGRAPHY EDUCATORS

42

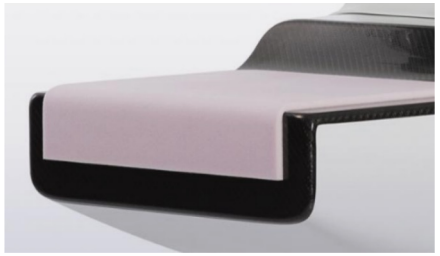
Progress

- These include a cushion for the breast on the surface of the mammography unit
- Compression paddles with fixed or dynamic tilt that distribute compression across the front and back of the breast
- A curved compression paddle to fit some breast contours
- A compression paddle control device used by the patient

MAMMOGRAPHY EDUCATORS

43

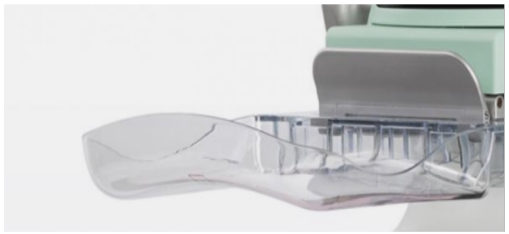
Providing comfort during an exam that's "less than comfortable".



MAMMOGRAPHY EDUCATORS

44

Paddles that "flex" or are "curved.



MAMMOGRAPHY EDUCATORS

45

Paddles that Determine Adequate Compression

- European-based company
- Paddle is based on the concept of optimized breast compression based on each individual breast

MAMMOGRAPHY EDUCATORS

46

Patient-Assisted Compression (PAC)

- Patient-Assisted compression doesn't impair mammographic quality
- Patient-Assisted compression increases breast compression and lowers dose
- Anxiety linked to mammography may be reduced
- Many patients reported overall satisfaction

MAMMOGRAPHY EDUCATORS

47

Patient-Assisted Compression (PAC)

"Seventy-four percent of patients reported that the self-compressing device would facilitate their reattendance"
-European Journal of Cancer, 2018

"52.8% declared they were less anxious compared to previous examinations"
-European Journal of Breast Health, 2019

MAMMOGRAPHY EDUCATORS

48

It's All About CONTROL

- Patients need to feel as though they are active participants in their exam
- This helps to reduce anxiety and fear associated with their mammogram

MAMMOGRAPHY EDUCATORS

49

How to Obtain Better Compression

- Establish a rapport and connection with the patient to ensure trust
- Educate the patient on what to expect and ensure that they are in control
- Explain how long compression may last

MAMMOGRAPHY EDUCATORS

50

The "Un-Compressibles"

- Explain that an under-compressed breast doesn't produce the quality needed
- Explain that subtle changes in the breast are difficult to see without proper compression
- Offer to have your patient auto compress
- Offer to reschedule at a time when the patient's breasts are less tender

MAMMOGRAPHY EDUCATORS

51

The "Un-Compressibles"

If you have virtually no compression:

- Tell the patient that you cannot submit images that are not of diagnostic value
- Offer to refer the patient to their physician in order to discuss alternative options for breast screening

MAMMOGRAPHY EDUCATORS

52

Compression and Communication

- Use analogies
- Choose your words wisely:
  - "Detect Changes" vs. "Detect Cancer"

MAMMOGRAPHY EDUCATORS

53

Building Confidence through Communication

- Allow the patient to play a part in the imaging process
- Reassure the patient
  - Tell them they're doing a "great job"
- Remember anxiety clouds intake
  - Look for non-verbal communication cues

MAMMOGRAPHY EDUCATORS

54

Choose Empathy, not Complacence

MAMMOGRAPHY EDUCATORS

55

Lack of standardization
Goal of compression
Common challenges
Tips for adequate compression

MAMMOGRAPHY EDUCATORS

56

References

- https://www.acraccreditation.org/-/media/ACRAccreditation/Documents/Mammography/Clinical_Image_SECTION_1999MammoQC.pdf?la=en
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5706300/
- https://www.sciencedaily.com/releases/2014/11/141125074824.htm
- https://www.volparahealth.com/news/breast-compression-pressure-affects-performance-of-breast-screening-program/
- https://www.fda.gov/radiation-emitting-products/mqsa-insights/compression-another-critical-factor-image-quality
- Ashley I. Huppe, Kelly L. Overman, Jason B. Gatewood, Jacqueline D. Hill, Louise C. Miller, and Marc F. Inciardi American Journal of Roentgenology 2017 209:6, 1419-1425
- https://www.ejcancer.com/article/S0959-8049(18)31126-2/fulltext#relatedArticles
- US Food and Drug Administration. Mammography Quality Standards. Final rule-21 CFR parts 16 and 900 [docket No. 95N-0192]. RIN 0910-AA24 ed. Washington, DC: Dept of Health and Human Services; 1997.
- Ulus S, Kovan Ö, Arslan A, Elpen P, Arıbal E. A New Technical Mode in Mammography: Self-Compression Improves Satisfaction. Eur J Breast Health 2019; 15(4): 207-212.

MAMMOGRAPHY EDUCATORS

Thank You!

Services we offer, include:
- Onsite Positioning Training
- Assistance with Accreditation & Inspection
- Live Webinars and Conferences
- On-Demand Continuing Education

For questions or more information:

619-663-8269
mammographyeducators.com
info@mammographyeducators.com

MAMMOGRAPHY EDUCATORS