The "Crushing" Truth about Compression

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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 aide in achieving adequate compression

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Mammography Technologists

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

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

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NOUN

com·pres·sion

/kəmˈpreSHən/

- The act of compressing or being compressed
  - The reduction in volume

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Compression in Mammography

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

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What's Required?

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

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

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ADJECTIVE

taut

/tôt/

- Stretched or pulled tight; not slack

"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."

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mber, 2014

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compression
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NCBI
Novembe

"While it is v
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quality, gui
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acquisition."

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Lack of standardization in compression guidelines results in:

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

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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

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1. *Lack of consistent compression guidelines*
    a. Inadequate image quality, higher recall rates and unnecessary pain for patients
2. Properly applied compression is one of the *most neglected yet most important* factors affecting image quality in mammography.

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

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Consistency in Compression

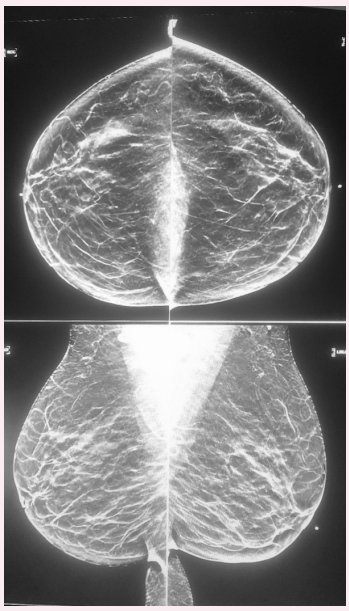

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TABLE 2: Compression Force and Posterior Nipple Line Measurements in 170 Patients in Study Group

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)

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How is Compression Measured?

Pounds daN N PSI kPa

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How is Compression Measured?

PSI
daN
lbs
N
kPa

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How is Compression Measured?

- PSI = Pounds per square inch
  - Pressure is measured in PSI
- kPa =kilopascal
- N = Newtons
  - 1 newton of force is the force required to accelerate an object with a mass of 1 kilogram 1 meter per second per second.
- daN = decanewtons (10 daN = 1 Newton)

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Compression force vs. Compression pressure

Pressure = Force / Contact Area

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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.

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

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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

FORCE IS AN "ACTION"

PRESSURE IS A "FEELING"

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Compression in Mammography

1. Image Quality
2. Cancer Detection

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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

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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

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

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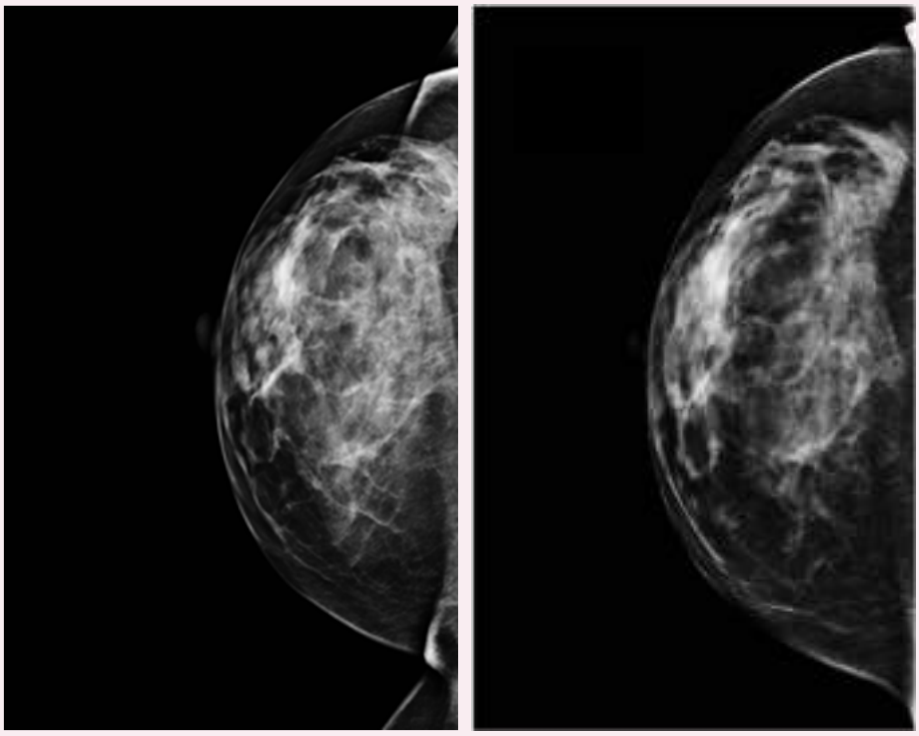

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Consistency and Compression

General Rule of thumb:
15% variance in compression

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

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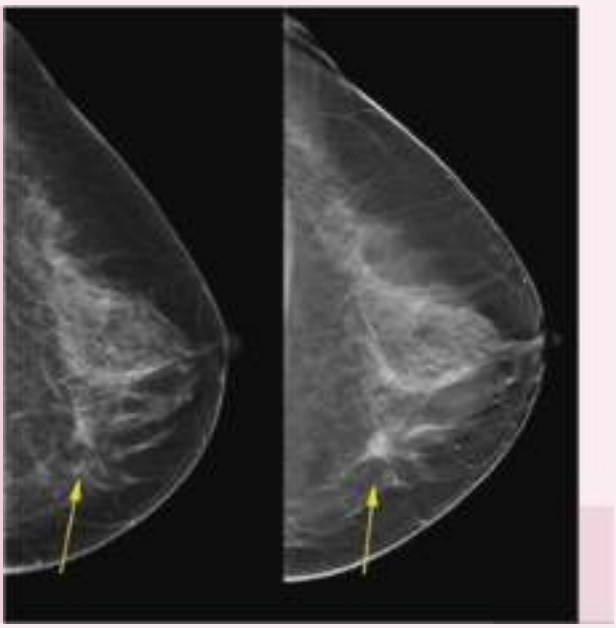
Cancer Detection

In adequately compressed mammographic exams



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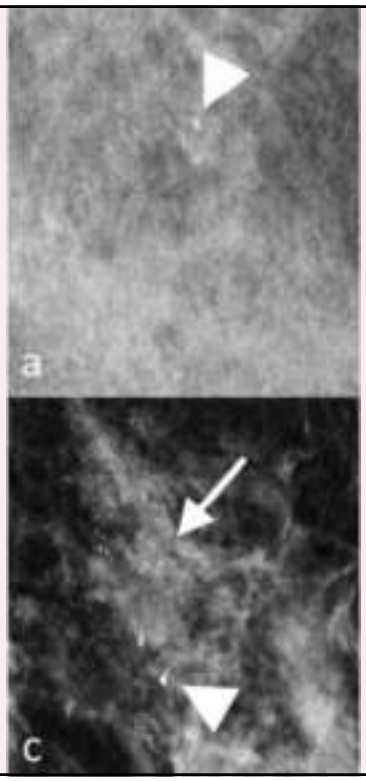
Inadequate Compression

Inadequate compression results in:
- limited beam penetration
- increased tissue overlap

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.

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



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The Importance of Anterior Compression

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Nipple Areolar Complex

- Approximately 10% of breast cancers
- Vascular Tissue / Subareolar Complex
- Adequate Compression is imperative
- Additional views

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"Overcompressing" the breast

Is over-compressing even possible?

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

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

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

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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 compression release when necessary

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Compression Testing

- Quality Control Tests
- Medical Physicist Tests

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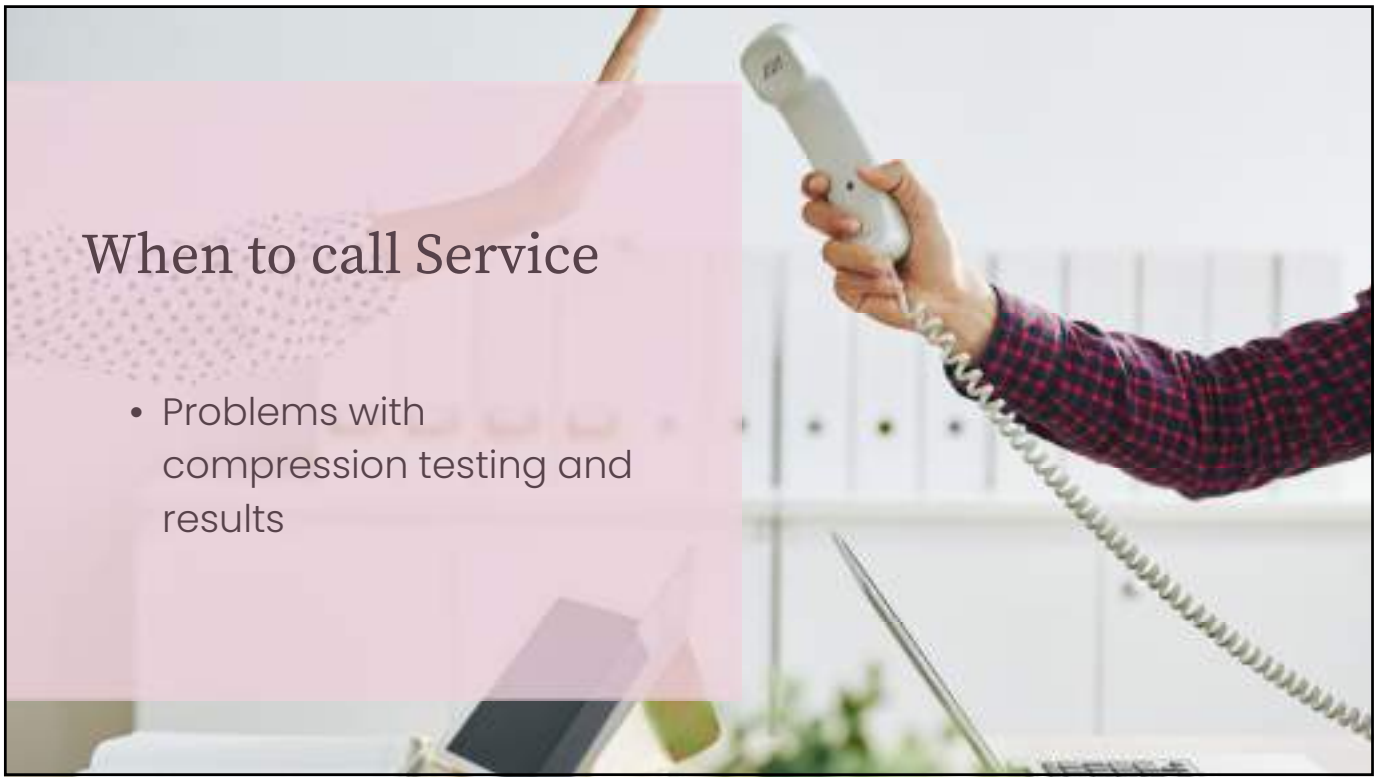

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"I wish there was a better way"....

Great news...
We're getting there!

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

- 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

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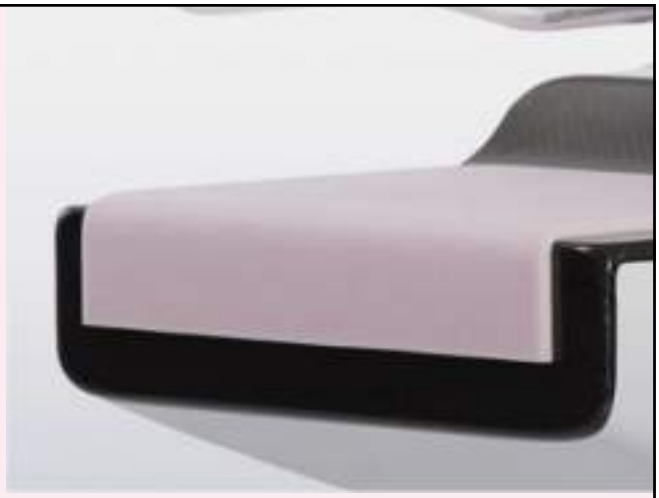
Providing comfort during an exam that's "less than comfortable"



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Paddles that "flex" or are "curved"

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Paddle that Determines Adequate Compression

- Dutch company: Sigmascreening
- Paddle is based on the concept of optimized breast compression based on each individual breast

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Patient Assisted Compression (PAC)

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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

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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

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It's 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.

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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 her that she's in control
- Explain how long compression may last

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The "Uncompressables"

- 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

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Compression and Communication

- Use analogies
- Choose your words wisely
  - “detect changes” vs. “detect cancer”

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Building Confidence through Communication

Examples:

- Allowing the patient to play a part in the imaging process
  - "Let me know if this gets beyond the point of uncomfortable; we'll work together to make changes if needed."
- Reassure the patient
  - Tell them they're doing a "great job"
- Remember Anxiety clouds intake
  - Look for non-verbal communication cues
    - a. rolling eyes,
    - gritting teeth
    - white knuckles

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- Lack of standardization
- Goal of Compression
- Common Challenges
- Tips for adequate compression

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Resources

- 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.

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Thank you !

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