# Physical Considerations of Mammosite

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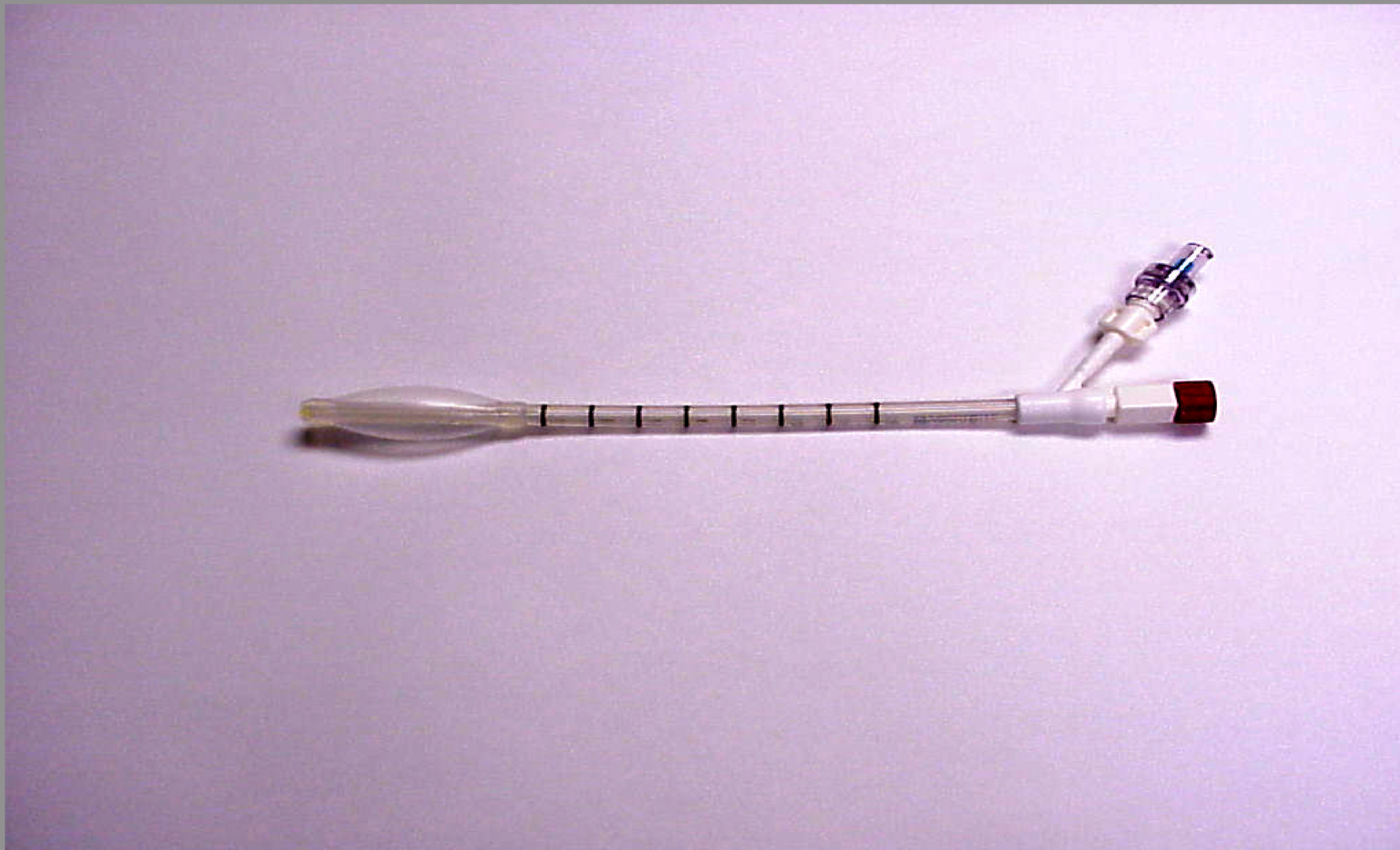
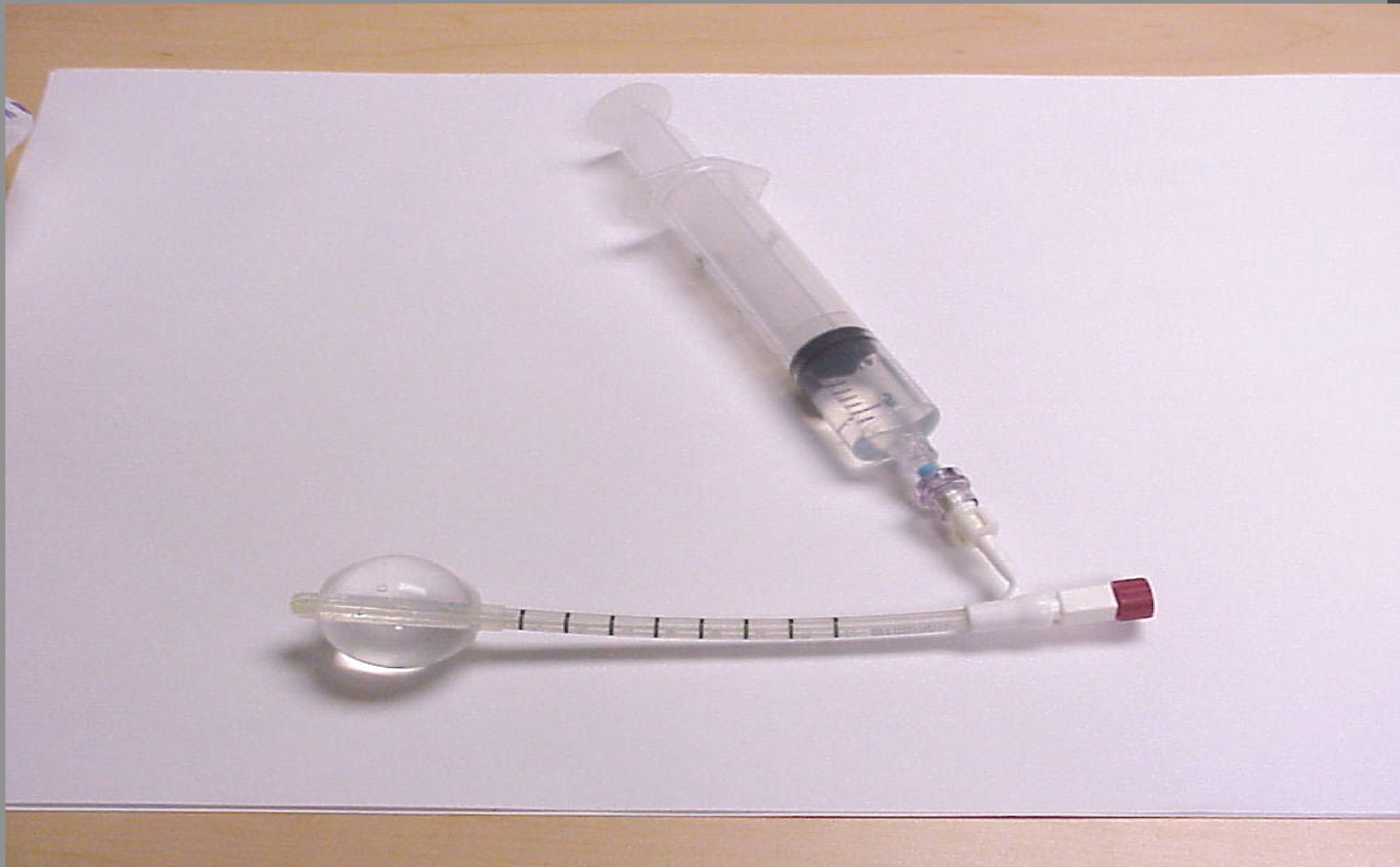
# Acknowledgement

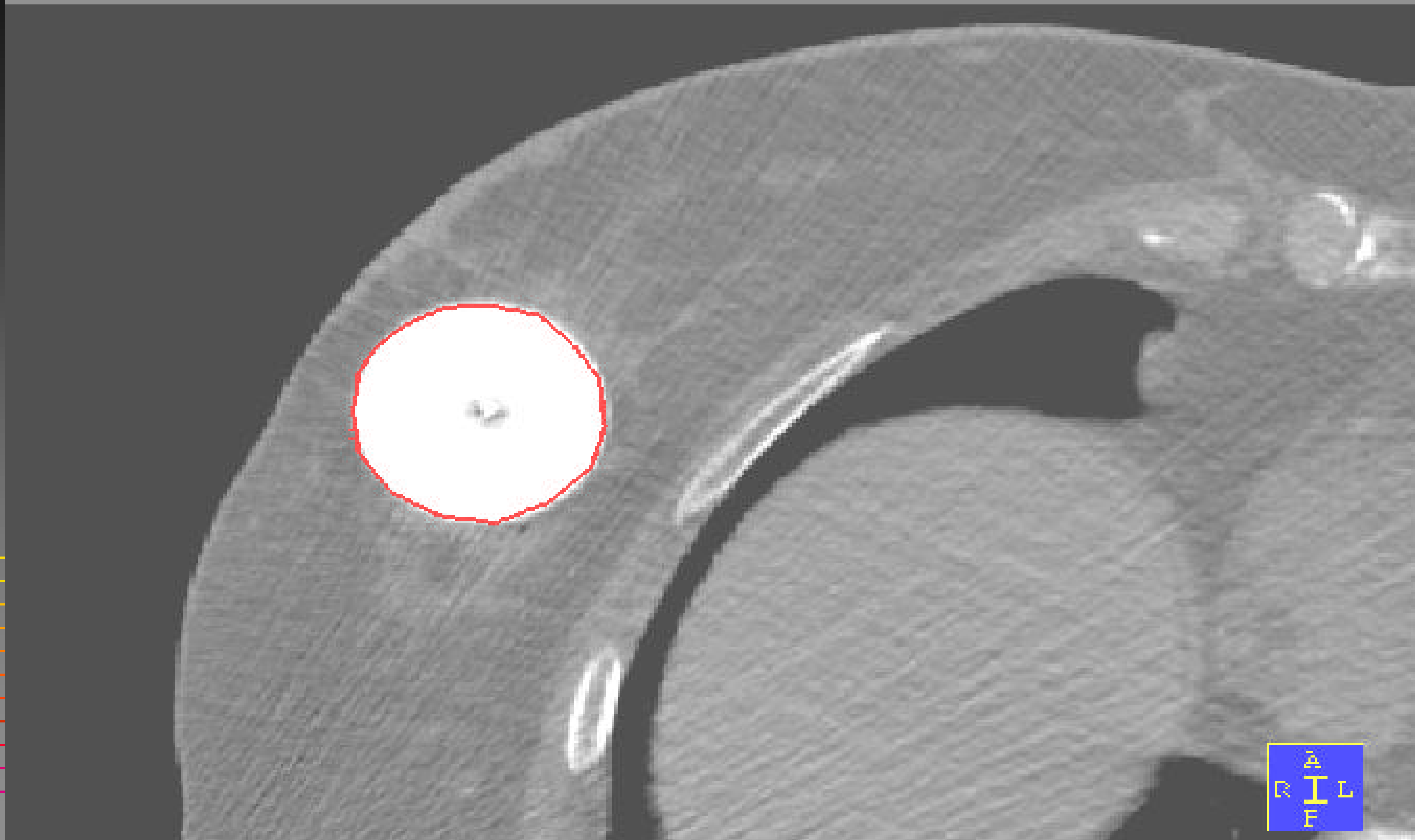
Many of the slides for this talk have come from Rupak Das's fine collection.

# Learning Objectives

- Understand the Principles and Practice of using Mammosite.
- Understand the limitations of using Mammosite.



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# Patient Selection

- Small tumors $\leq$ 1.5 cm diameter
- Roundish cavity
- Inserted during or soon after tylectomy

# Prescribed Dose

The same as with catheter-based breast implants:

Standard: 8 fx of 4 Gy (32 Gy) for $BED_{Gy10}$=44.8

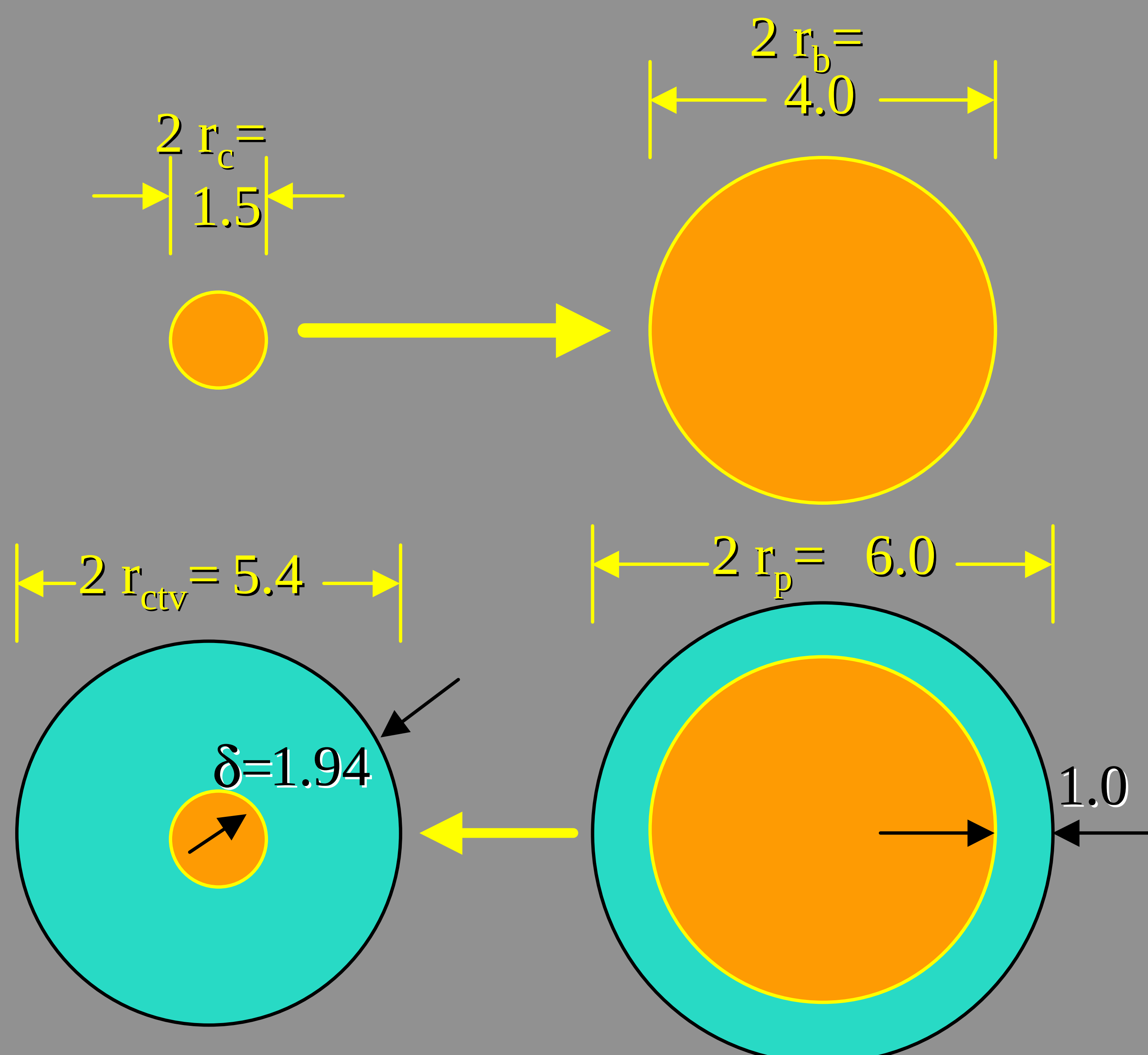
For younger patients or less robust:

10 fx of 3.4 Gy (34 Gy) for $BED_{Gy10}$=45.6)

# Prescription Location

The prescribed dose is delivered to 1 cm beyond the balloon surface.

# Theory Behind Dose Point




- The balloon expands the cavity from 1.5 cm to 4.0 cm.
- The 1 cm margin for the expanded cavity corresponds to an approximately 2 cm margin for the collapsed cavity.

# How the Margin Relates

Assume the volume in blue remains constant

(Where could it go?)

$$V = \frac{4\Pi}{3}(r_p^3 - r_b^3) = \frac{4\Pi}{3}(r_{ctv}^3 - r_c^3)$$

$$r_{ctv} = r_c - \delta$$

$$\Rightarrow \delta = \sqrt[3]{r_p^3 - r_b^3 + r_c^3} - r_c$$

# Some Examples

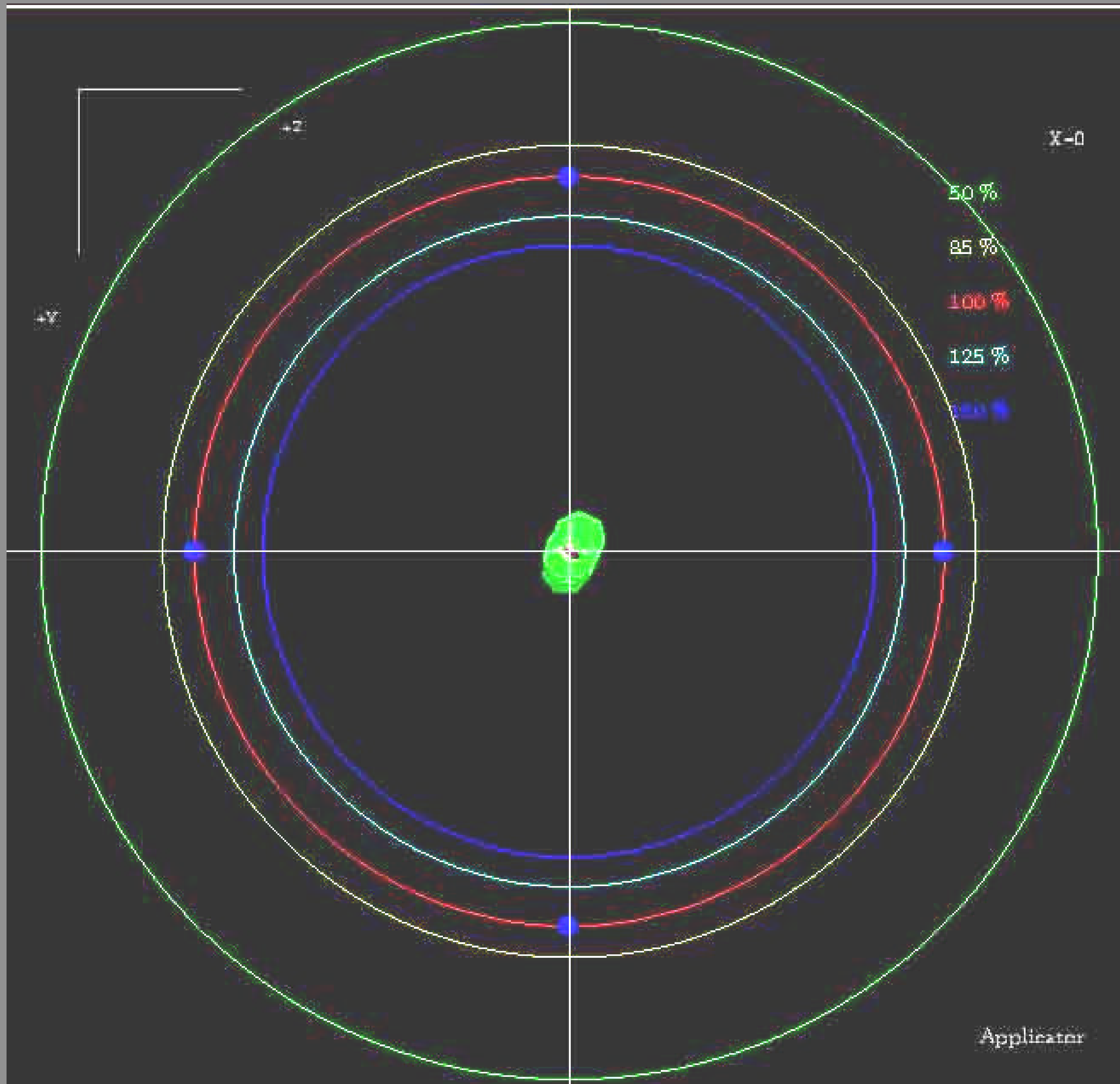
| | | | |
|---|---|---|---|
| Cavity size ($2r_c$) | 1.5 | 1.5 | 1.0 |
| Balloon size ($2r_b$) | 4.5 | 4.0 | 4.0 |
| Margin with balloon | 1.0 | 1.0 | 1.0 |
| Treatment diameter ($2r_p$) | 6.5 | 6.0 | 6.0 |
| Margin around cavity ($\delta$) | 2.1 | 1.9 | 2.2 |
| CTV diameter ($2r_{ctv}$) | 5.7 | 5.4 | 5.3 |

All dimensions in centimeters

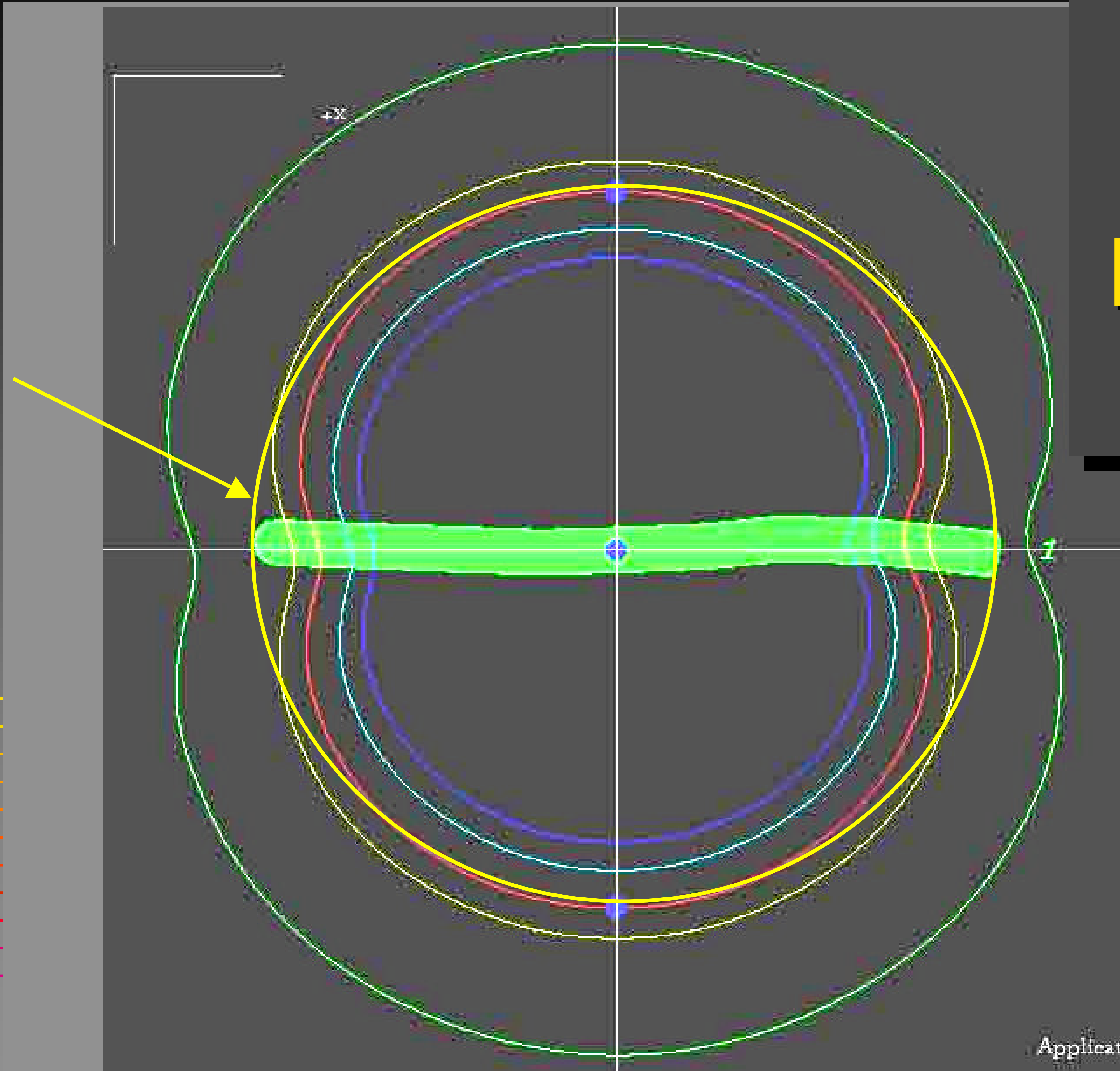
# And So

The volume of the breast treated is actually quite large.

# Isotropic in the Transverse Plane



# Anisotropic in the Longitudinal Plane



# Procedure

- Placement: Often by surgeon – could be by radiation oncologist.
- Localization: CT is necessary (we will see why).
- Dosimetry: Takes little time.

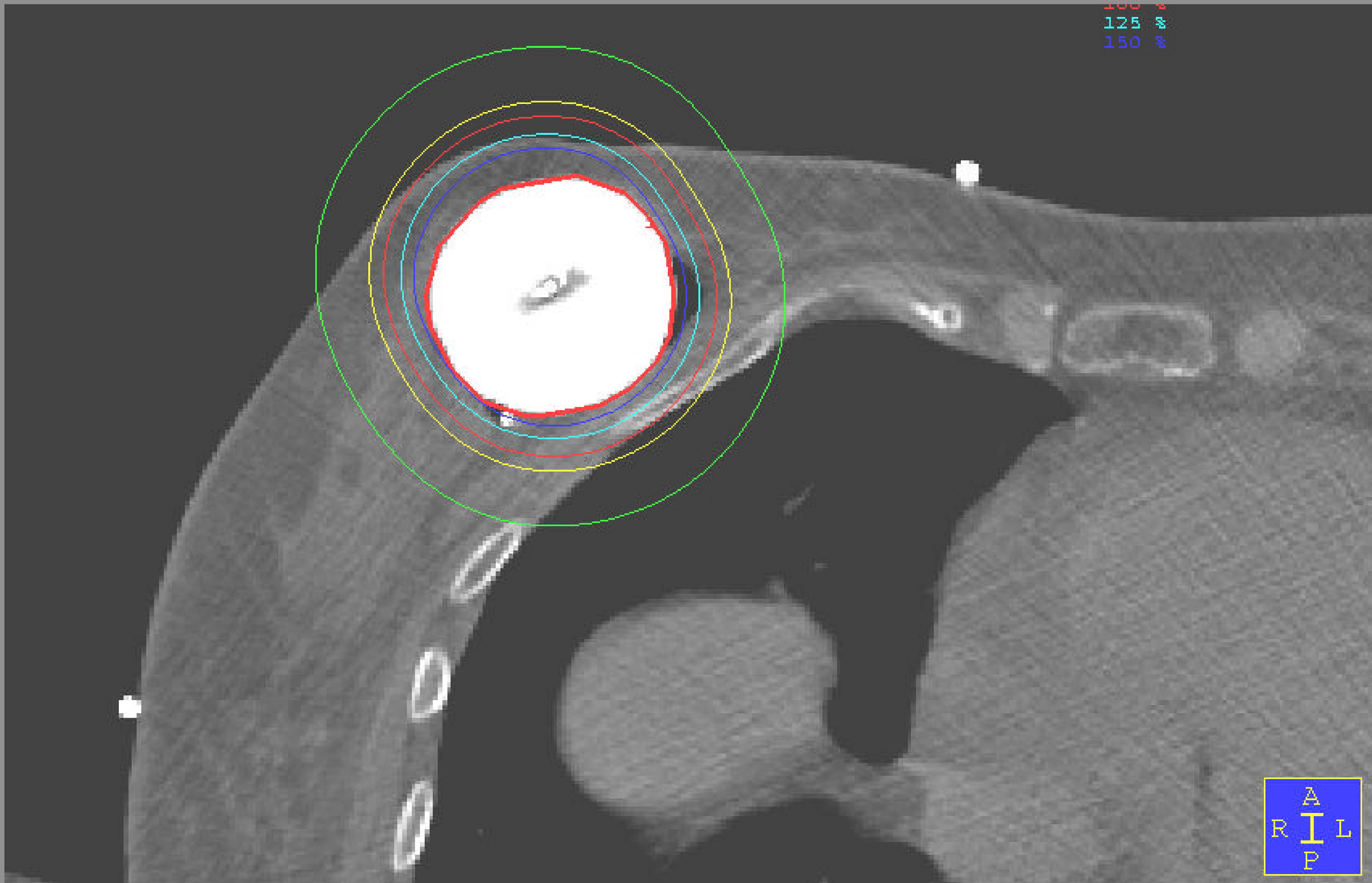
# Planning Criterion 1

Applicator should be at least 1 cm away from the skin.

- Acceptable as close to skin as 0.6 cm.
- Skin *will* exceed 100%.
- Skin *should not* exceed 150%.

Example: (radius to PD/radius to skin at 0.6 cm)$^2$

=(3.0 cm / 2.6 cm)$^2$ = 1.33 => Skin dose = 133%.



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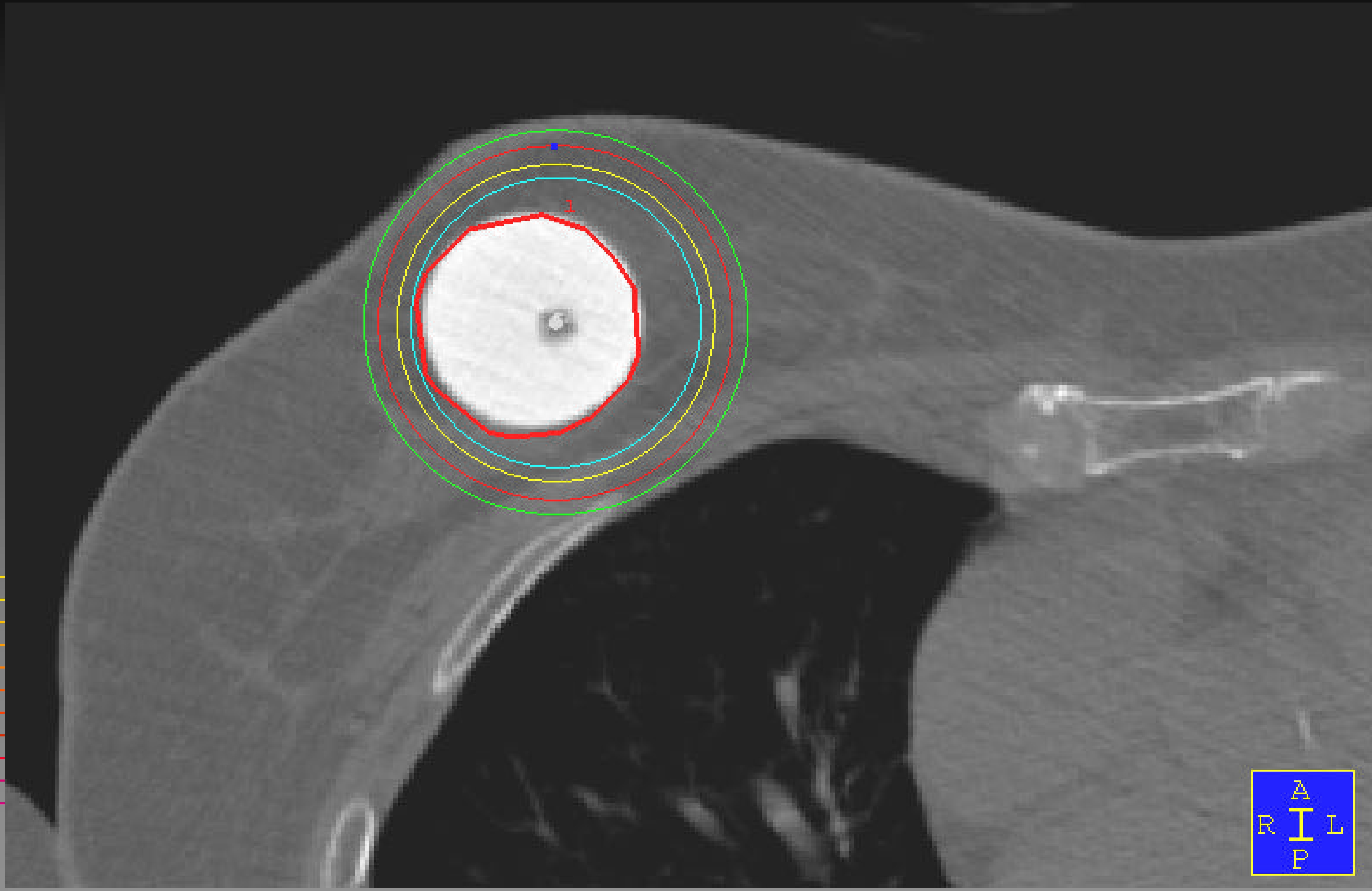
# Planning Criterion 2

Source should be centered with respect to the applicator

(except when avoiding the skin if balloon is too close.)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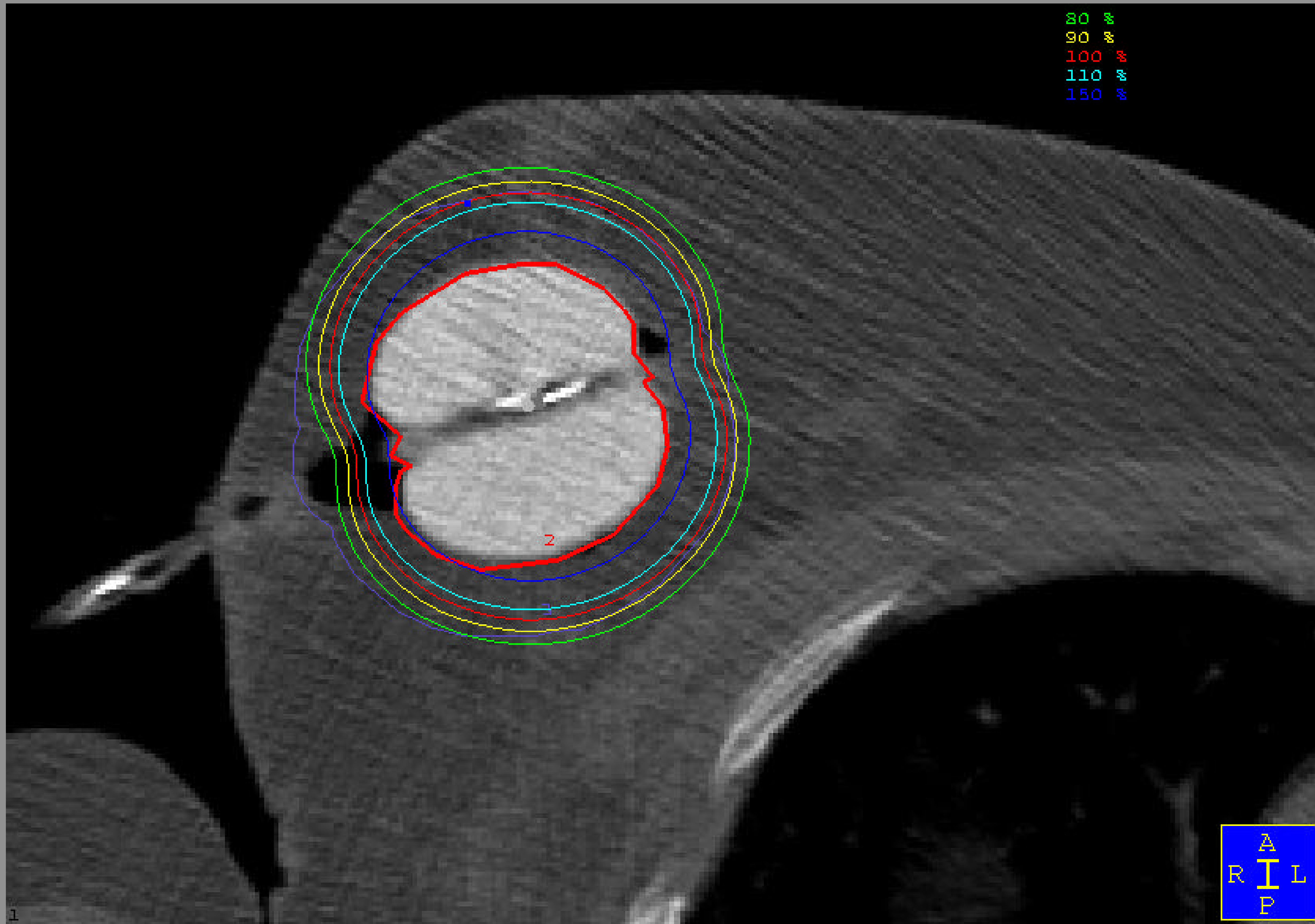
# Planning Criterion 3

Be weary of voids!

They push the target tissue away from the source.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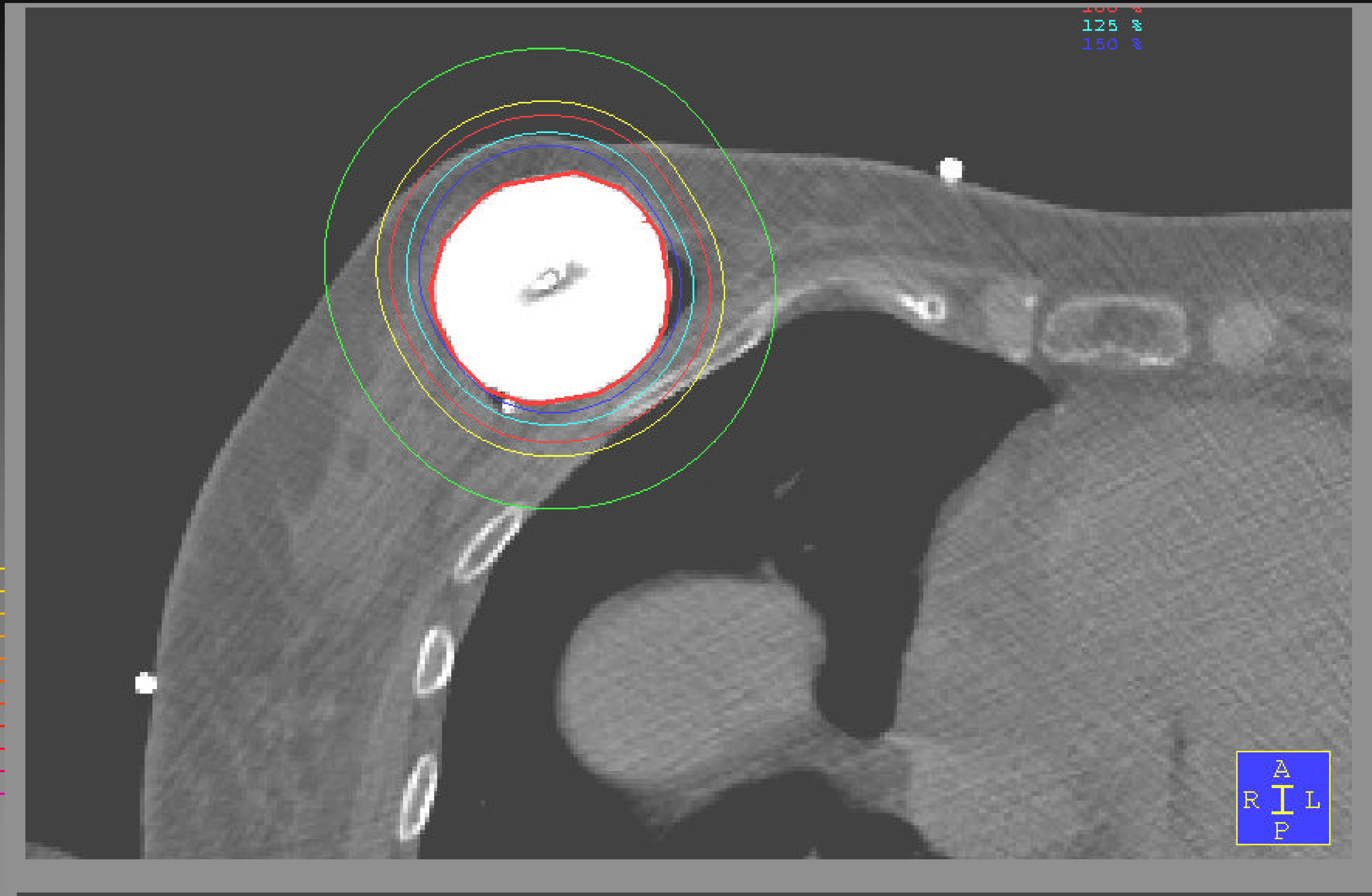

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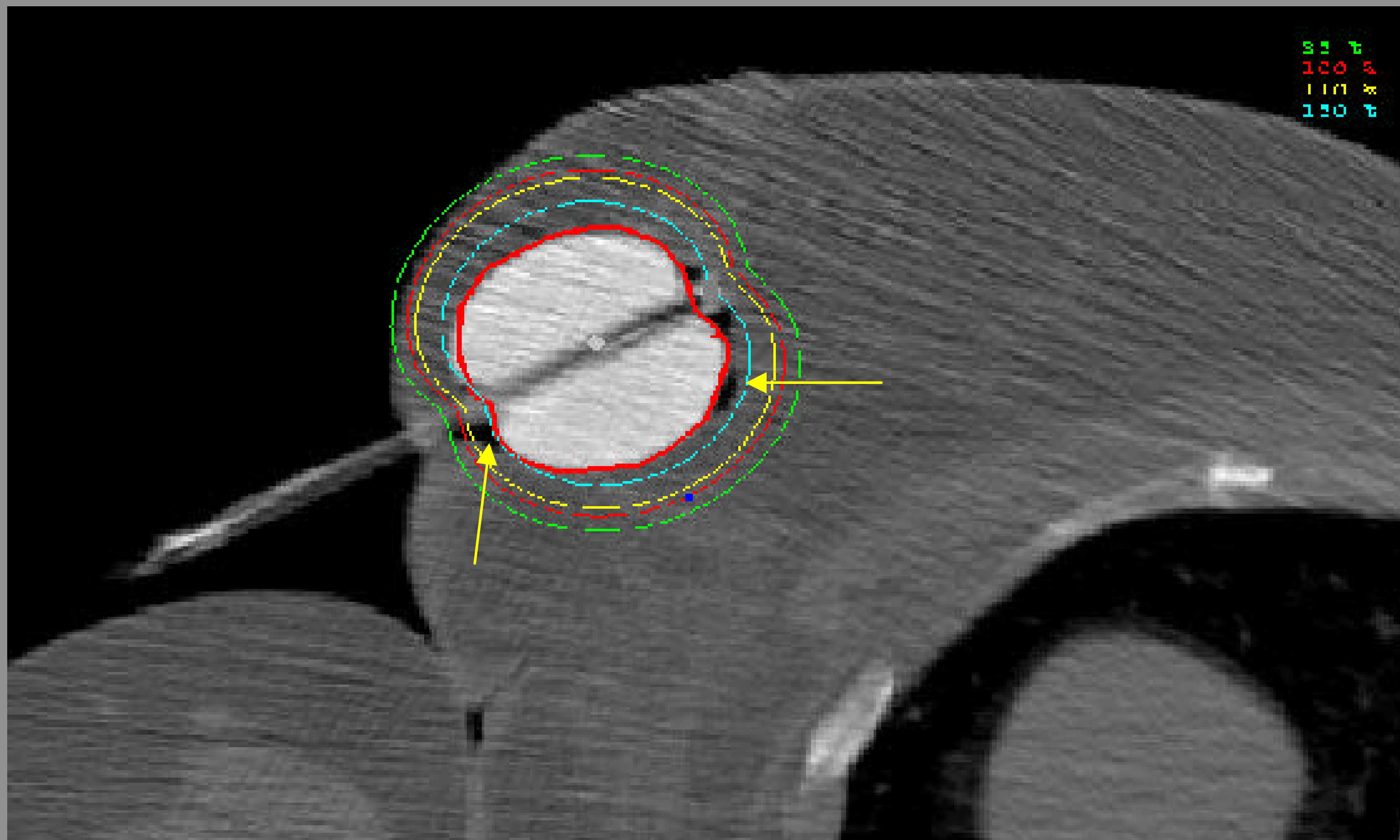
# Insidious Little Voids



# Quality Assurance

$$D(r) = \Lambda S_k \frac{g(r)}{r^2} t$$

| | | | |
|---|---|---|---|
| $\Lambda$ | Dose rate constant | 1.12 cGy/hrU | |
| $S_k$ | Air Kerma Strength | | U |
| g(r) | Radial dose function | 1.02 | $cm^2$ |
| r | Distance | | cm |
| t | Time | | secs |
| sec to hr conversion | | 0.000278 hr/sec | |

# Quality Assurance

Other things to check:

- Channel Length
- Balloon Diameter
- Source Position Center
- Step Size

# Pretreatment Check

Integrity of applicator before each treatment

(or at least once a day)

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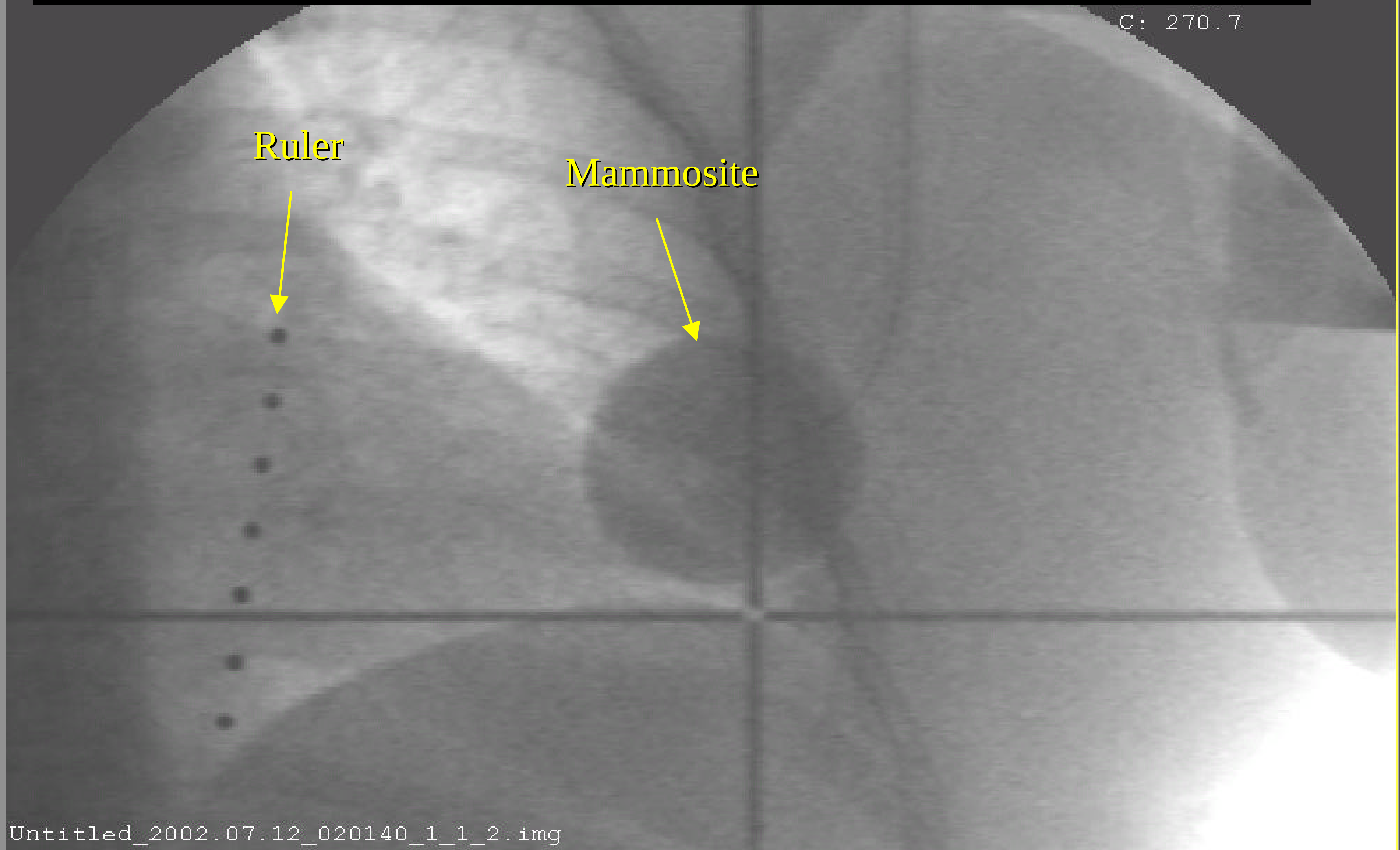
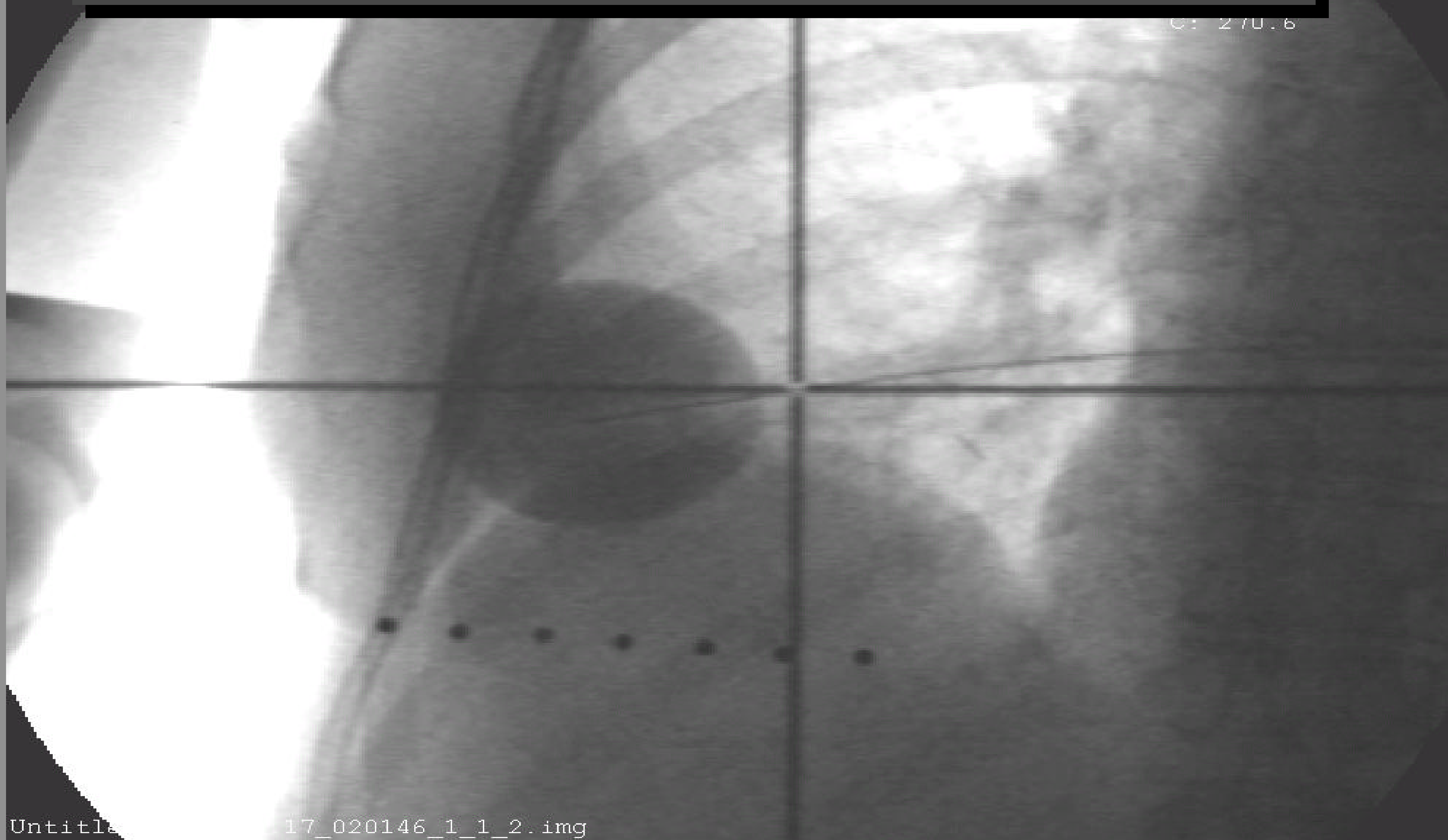


# Another Pretreatment Check



# And in the End

The checks *are* important. Any problems are reason to abort the procedure.

There have been problems – several that would have been prevented by following the checks.

# And the Problems Have Been…

- Balloons have leaked, leading to high doses as the tissues move closer to the source.
- Balloons have popped, probably because of pushing against clips.
- Mistake in treatment planning led to the source positioning at the edge of the balloon.

# Conclusions

1. Mammosites are relatively quick and easy to insert.
2. They only are appropriate for small cavities.
3. The dosimetry is simple.
4. The treatment margin *may* be adequate (if the assumption of conservation of volume holds).
5. The volume of the breast treated is substantial.
6. Skin doses are large compared to interstitial implants, and so may doses to pects or lungs.
7. Verification checks must be taken seriously!

# Acknowledgments


- Robert R. Kuske, M.D.
- Rupak Das, Ph.D.
- Heath Odau, M.S.
- Rakesh Patel, M.D.
- Kim Brandt, RN, MBA
- Cathy Eastman, RN
- Karen Guthrie, RN