

Physics of stereo vs. tomosynthesis-guided breast biopsy

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July 2020



Outline

- Clinical background
- Principle of
 - Stereo imaging
 - Tomosynthesis imaging
- Imaging during a biopsy procedure
- Pitfalls
- Summary & Conclusion



Follow-up Testing Risks of Mammography Screening

Out of every **100** women who get a screening mammogram:

90 will be told that their mammograms are normal



10 will be asked to return for additional mammograms or ultrasounds

6 will be reassured that their mammograms are normal



2 will be asked to return in 6 months for a follow-up exam



2 will be recommended to have a needle biopsy



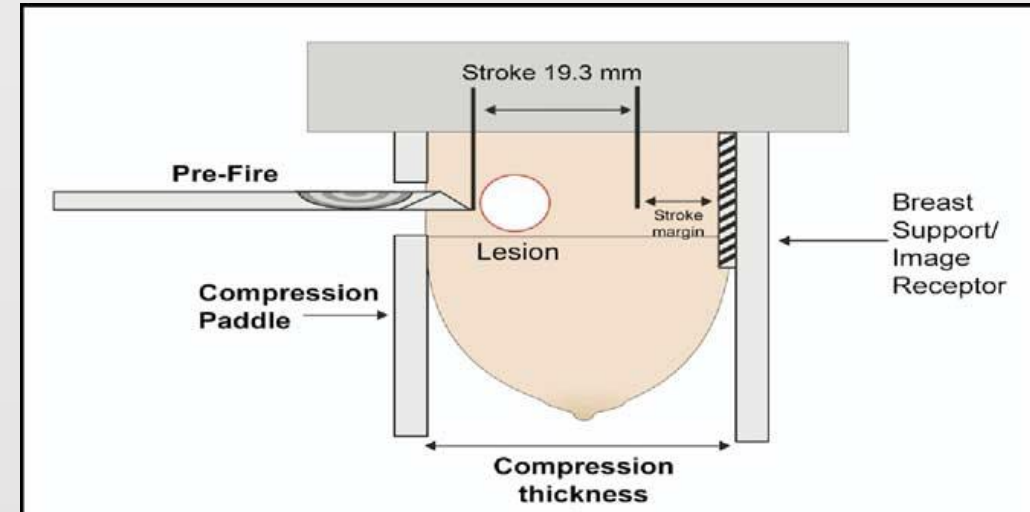
To learn more about mammography benefits and risks visit mammographysaveslives.org



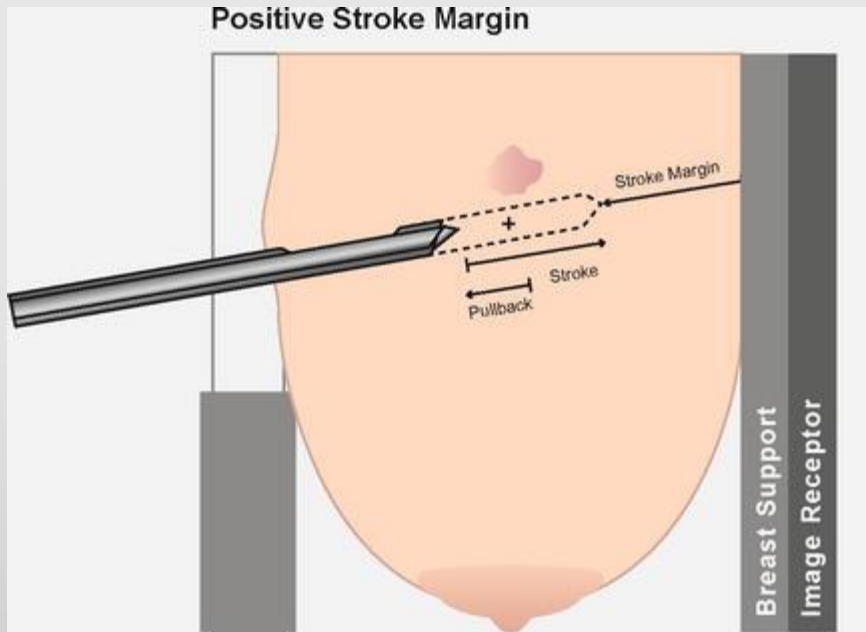
Biopsy needle



Performing a biopsy



Stroke Margin

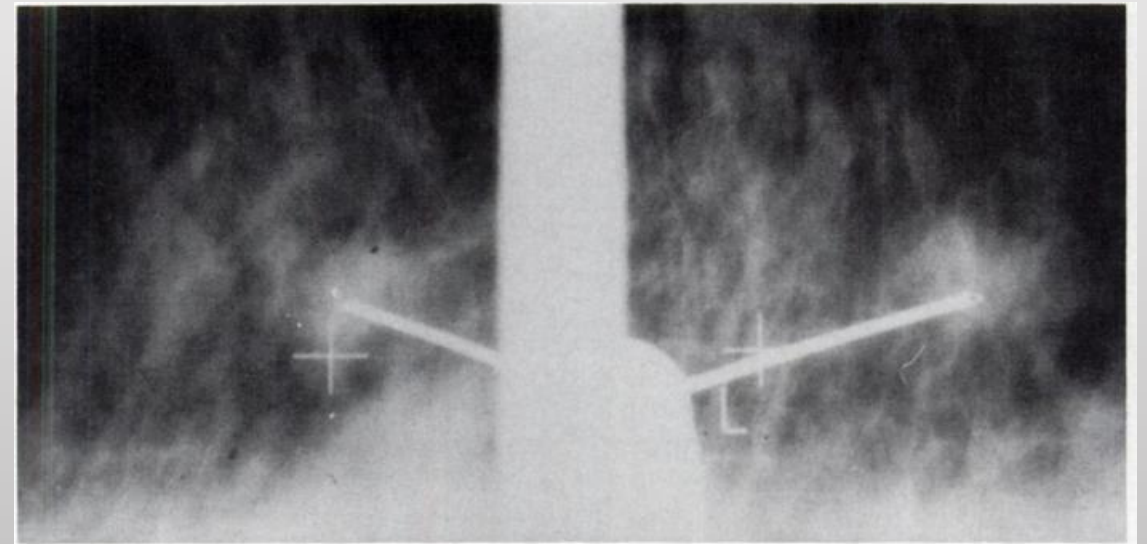
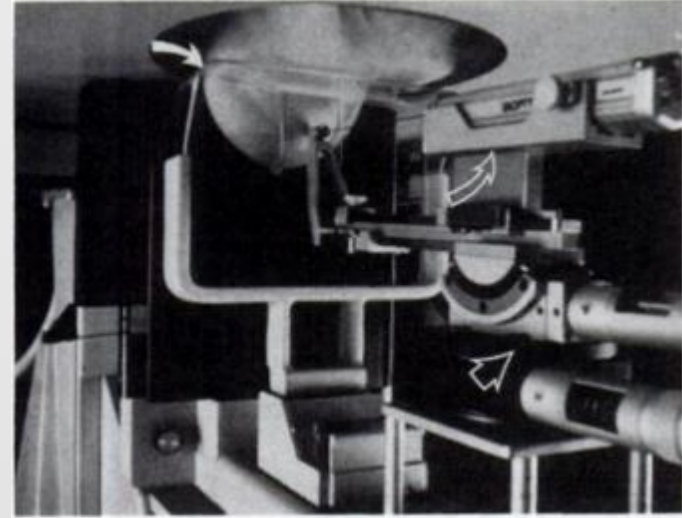


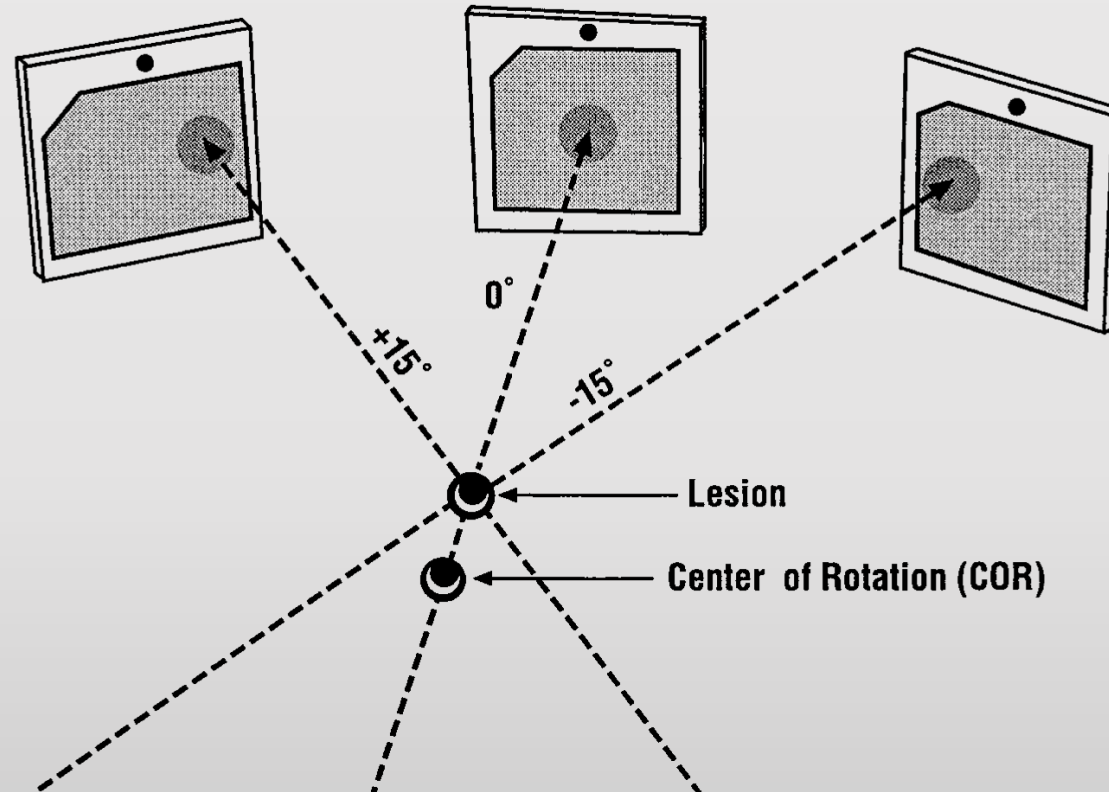
Breast biopsy ~ 1990

Image-based target localization in the breast becomes available

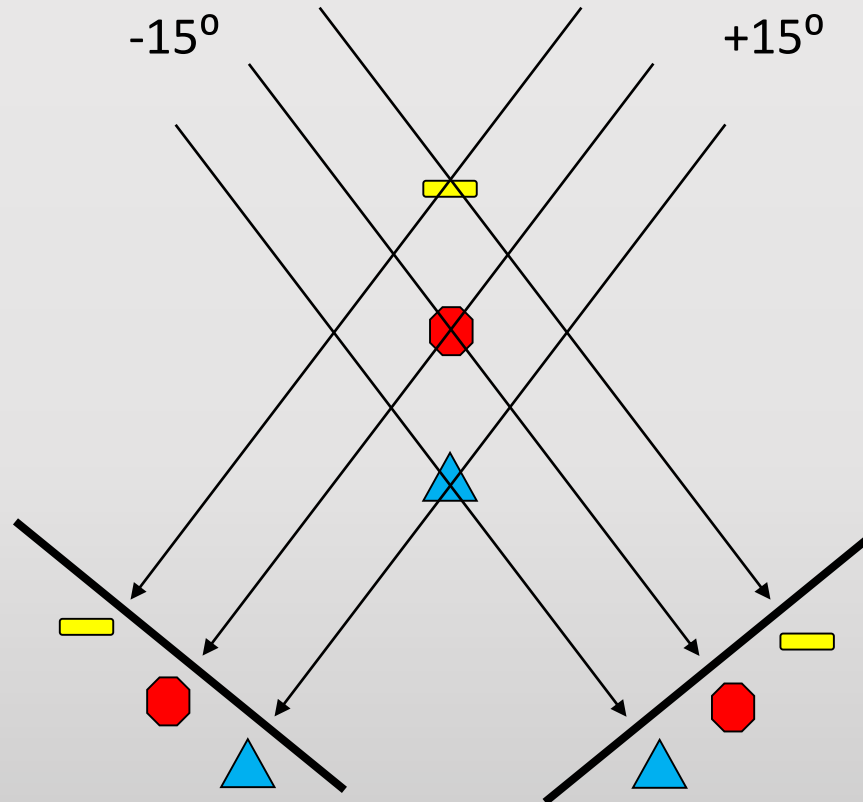
- enables use of a biopsy gun for breast biopsy

-> stereotactic breast biopsy

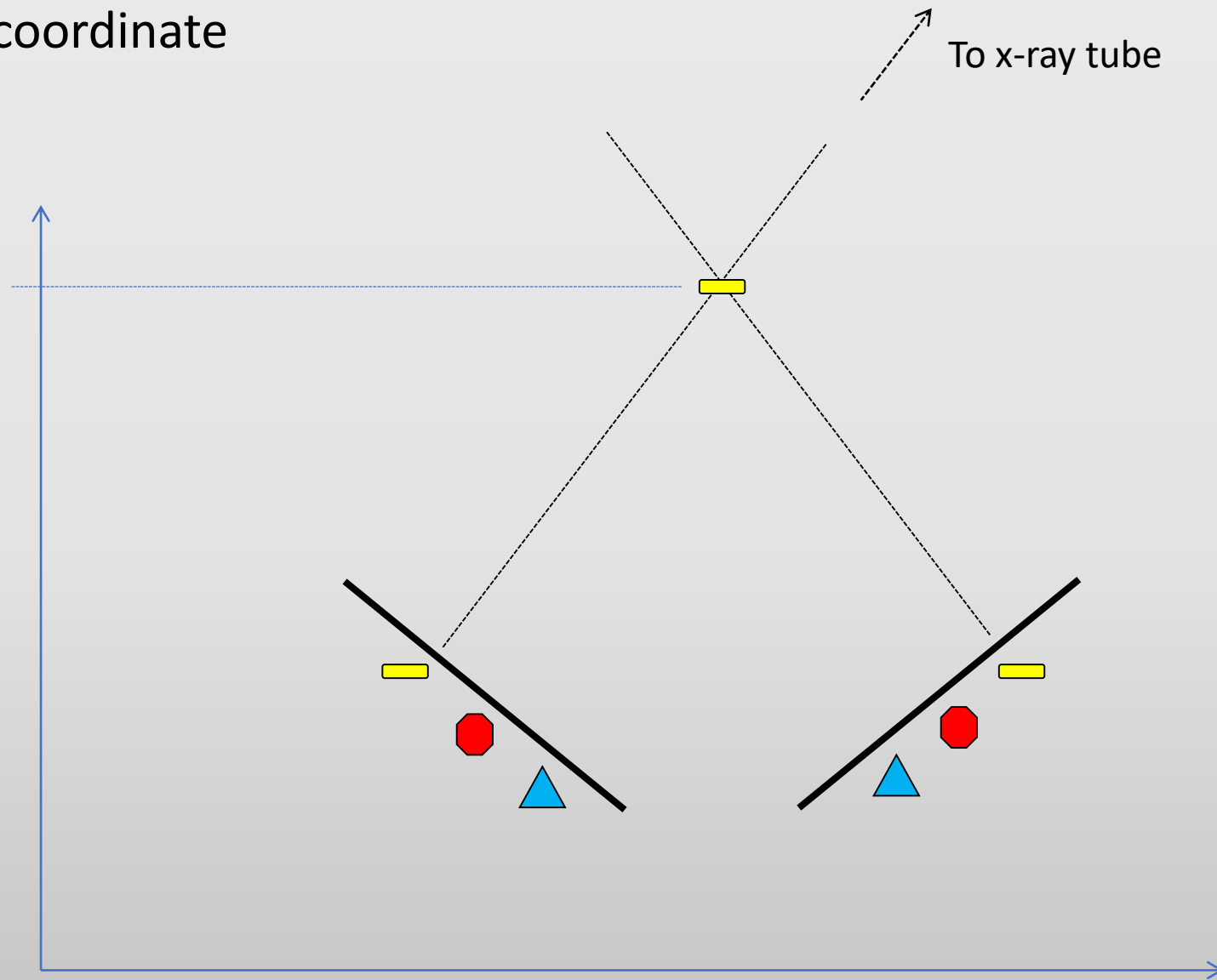




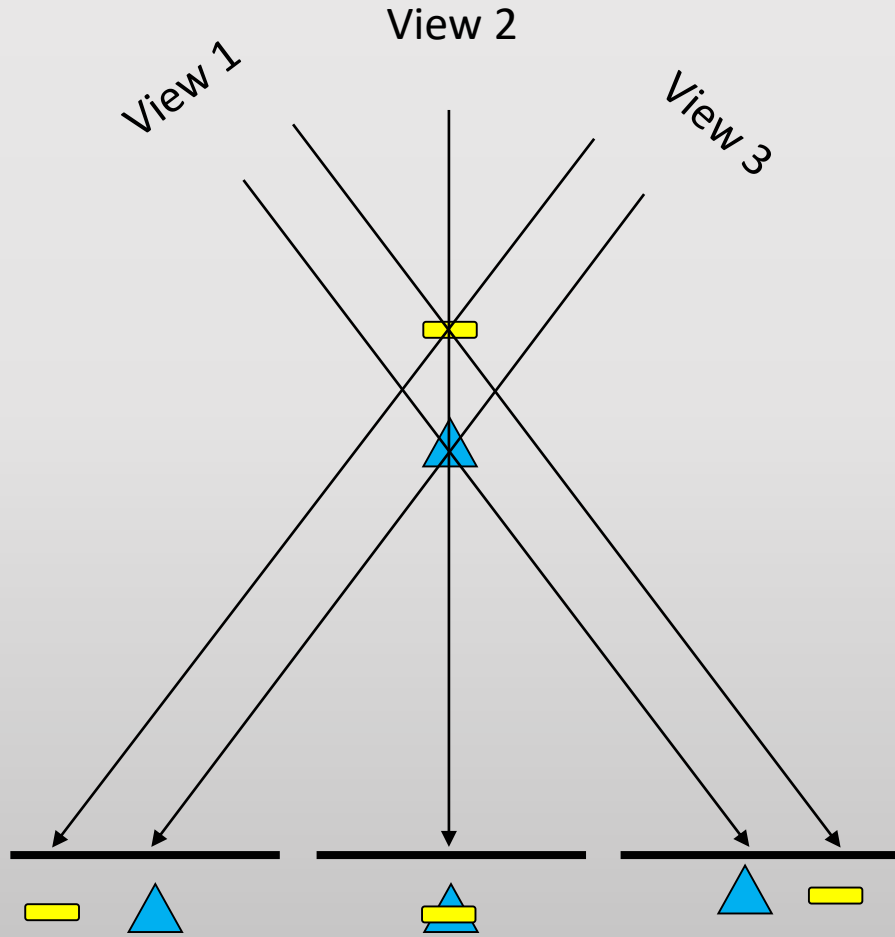
Second Stereo Image



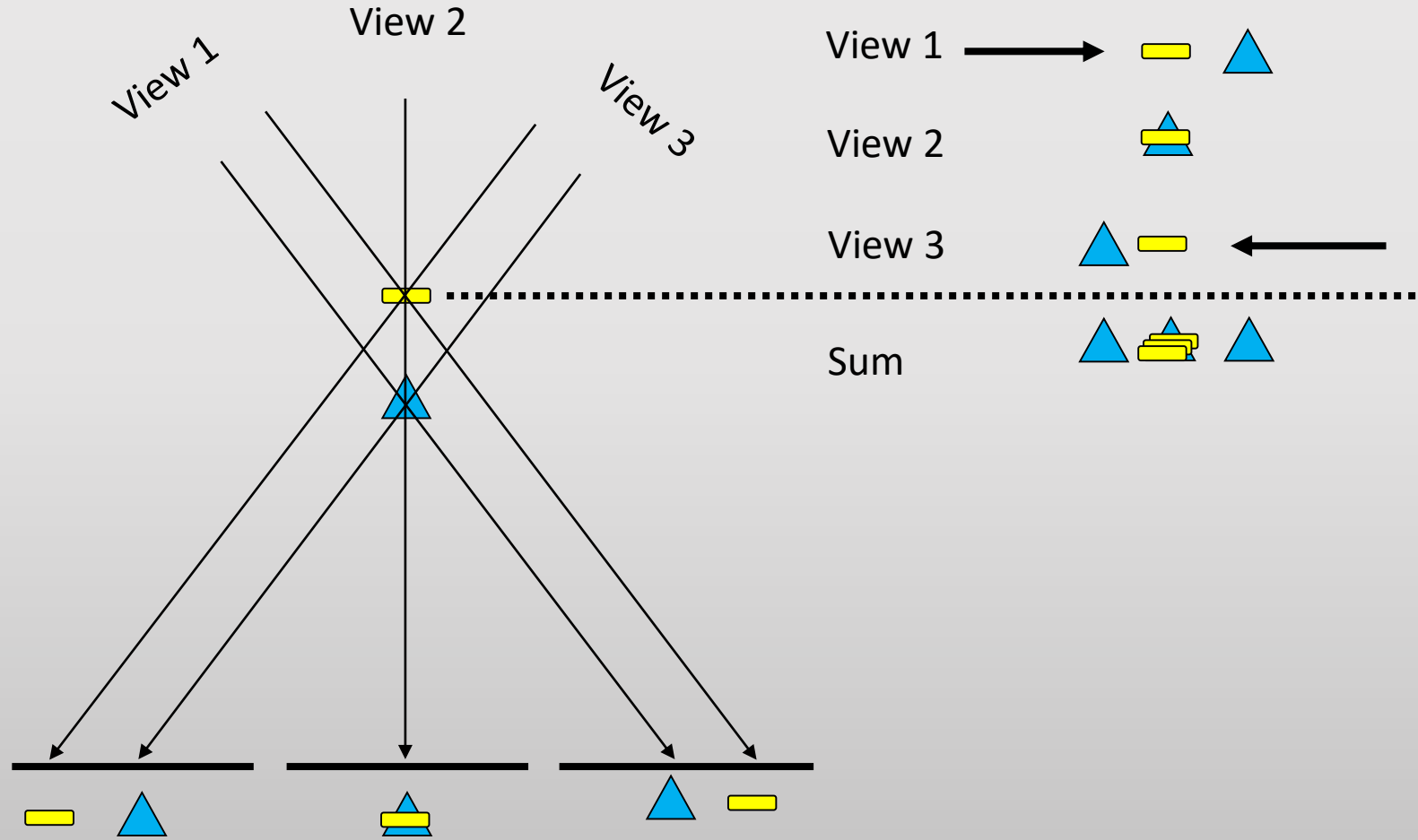
Z-coordinate



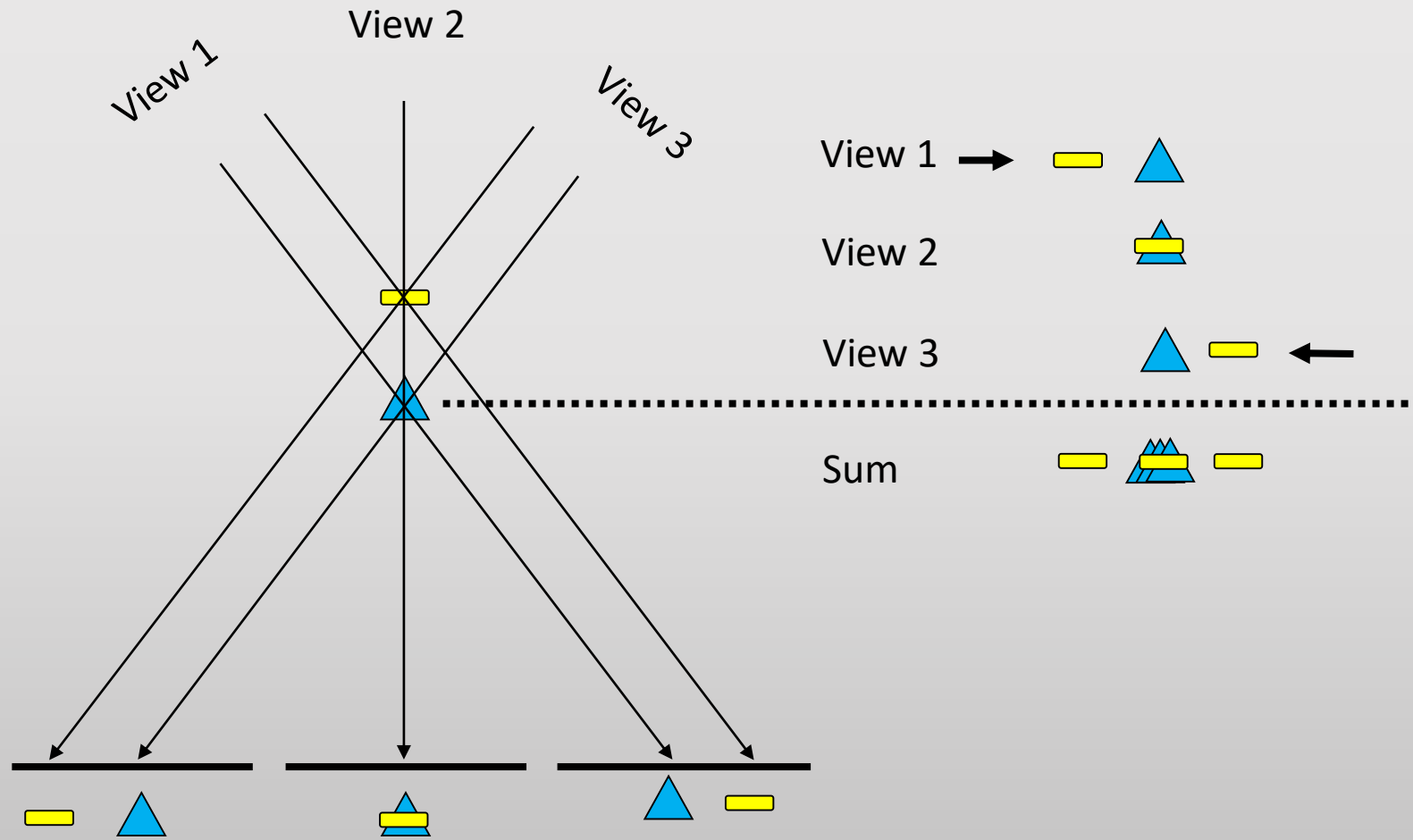
Tomosynthesis Basics



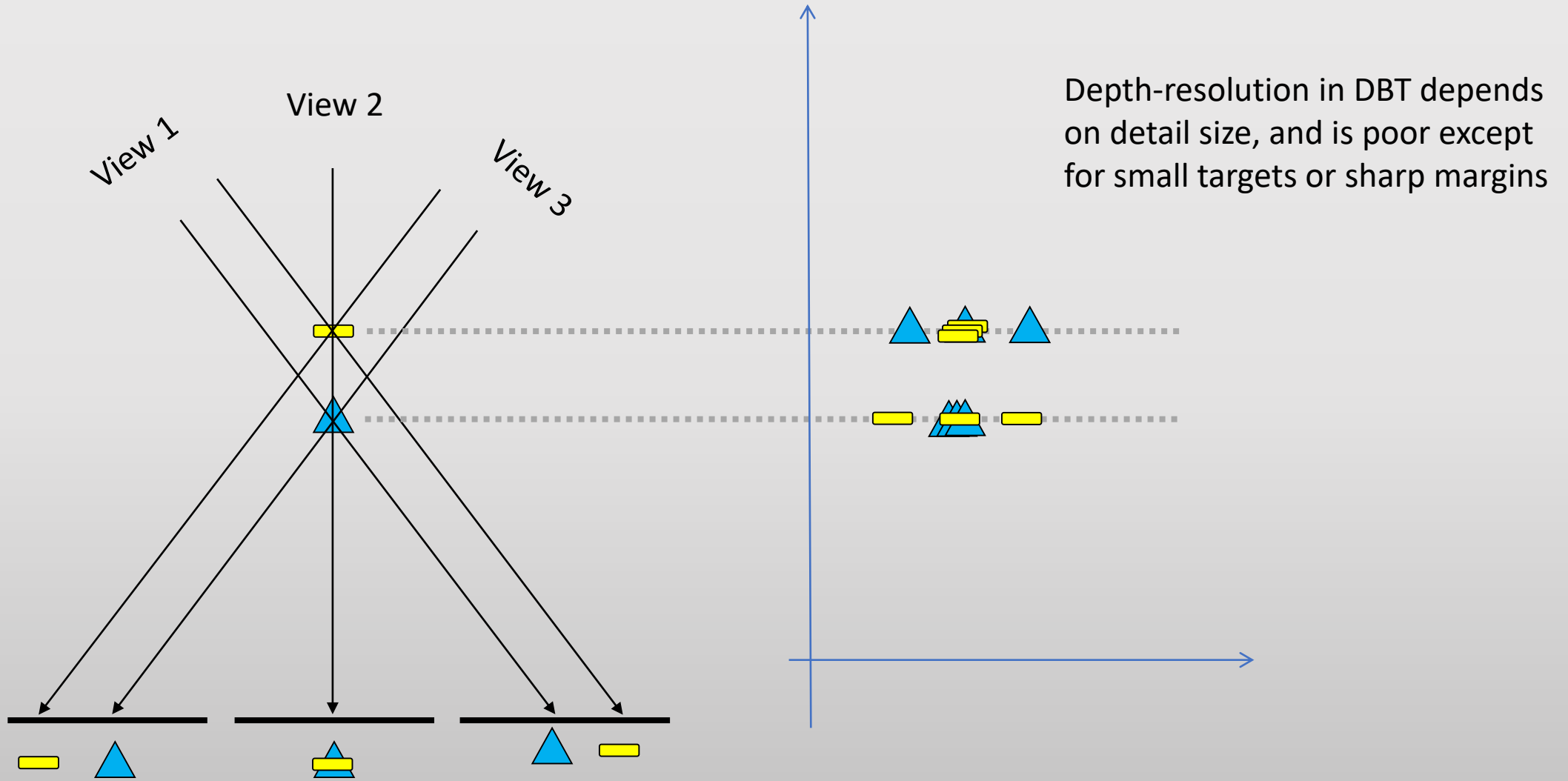
Tomosynthesis Basics



Tomosynthesis Basics



Tomosynthesis Basics



Imaging during the biopsy procedure

Stereo guidance

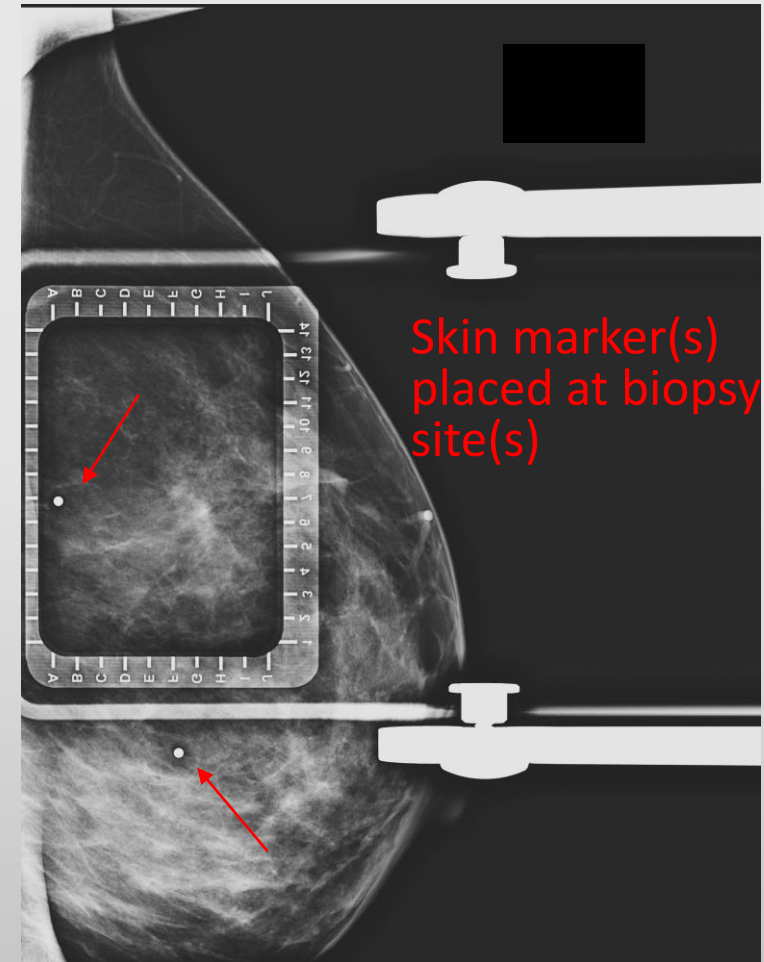
- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- Specimen images



Imaging during the biopsy procedure

Stereo guidance

- **Pre-procedure mammogram**
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- Specimen images

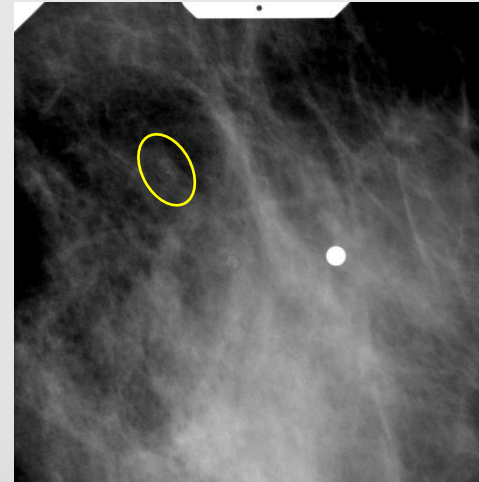


Imaging during the biopsy procedure

Stereo guidance

- Pre-procedure mammogram
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 - **Stereo scout**
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- Specimen images

Stereo scout



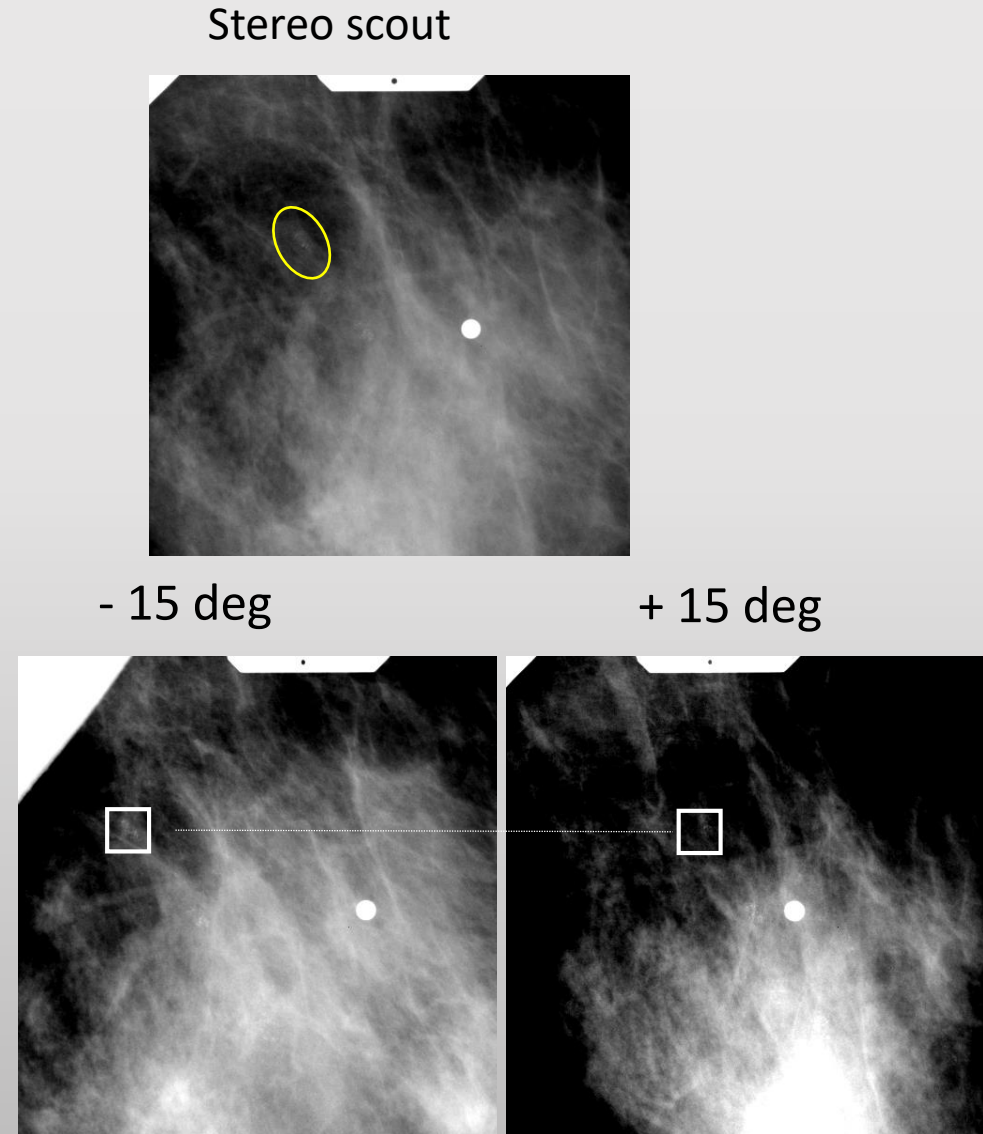
Biopsy target
near center of
biopsy window



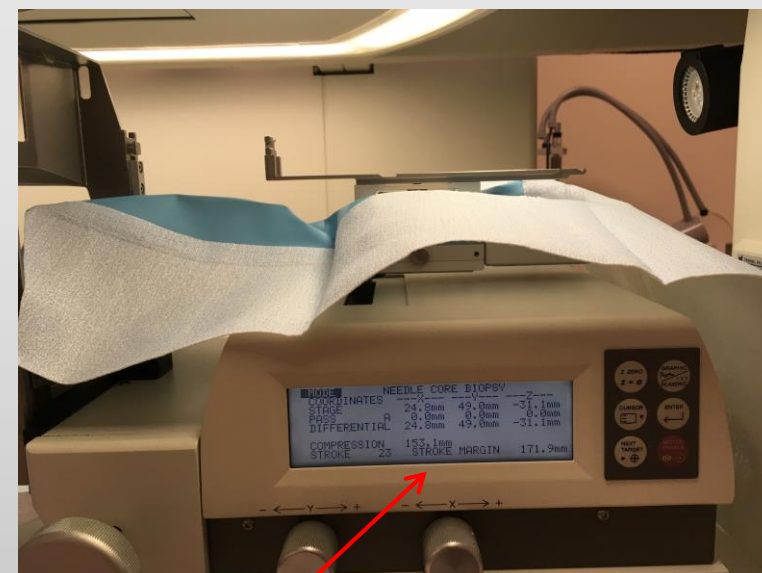
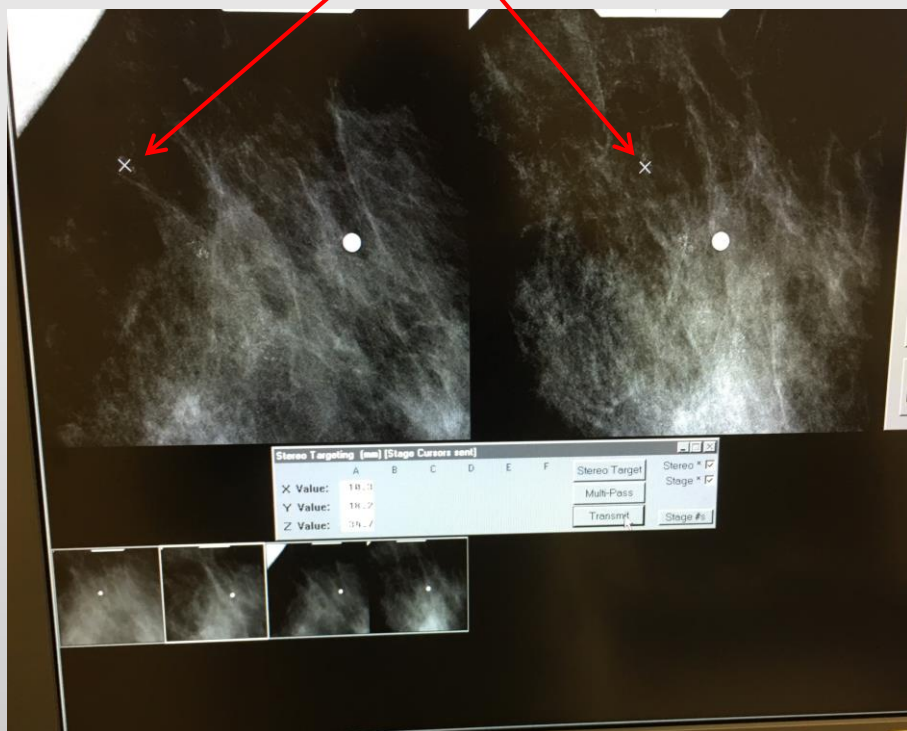
Imaging during the biopsy procedure

Stereo guidance

- Pre-procedure mammogram
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 - **+/- 15 degree stereo pair**
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- Specimen images



Target is marked, system calculates target coordinates



Coordinates are transmitted to
needle guidance system

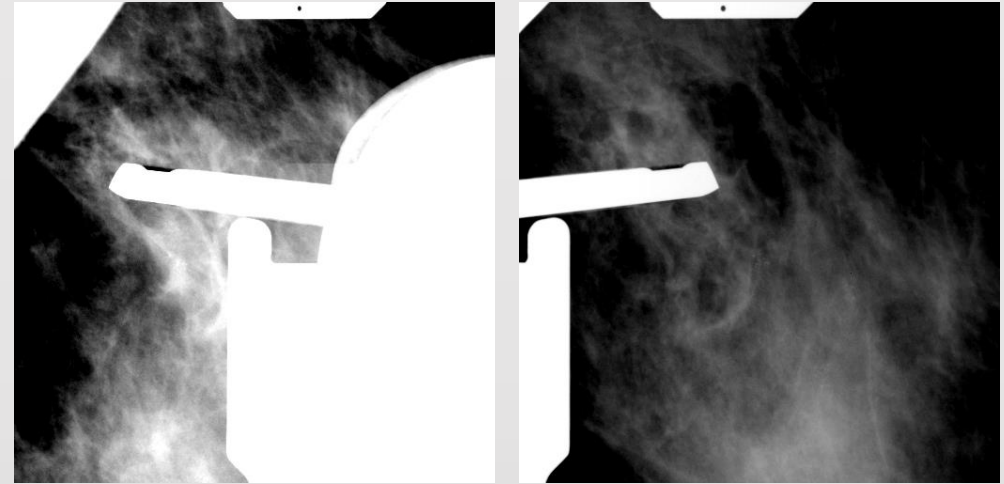


Imaging during the biopsy procedure

Stereo guidance

- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - **Pre-fire stereo pair**
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- Specimen images

Pre-fire stereo pair



If target is lined up with needle, fire needle

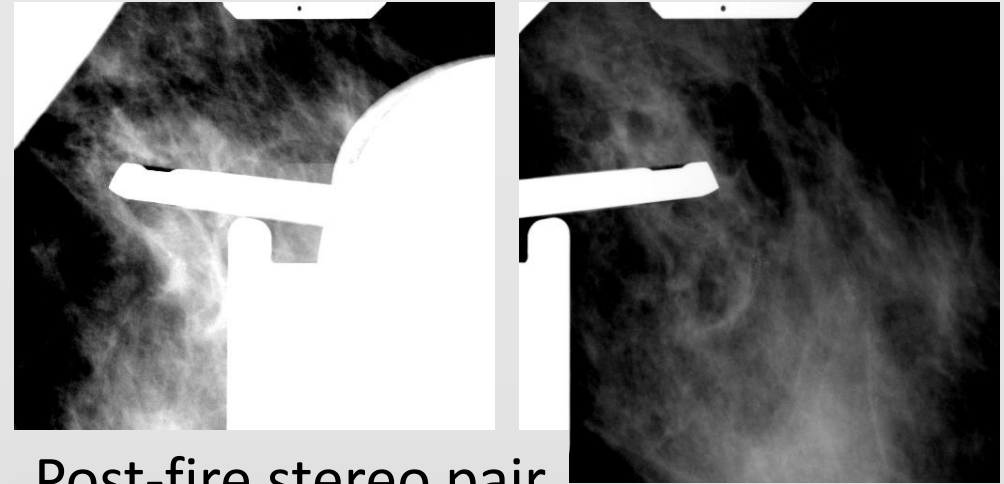


Imaging during the biopsy procedure

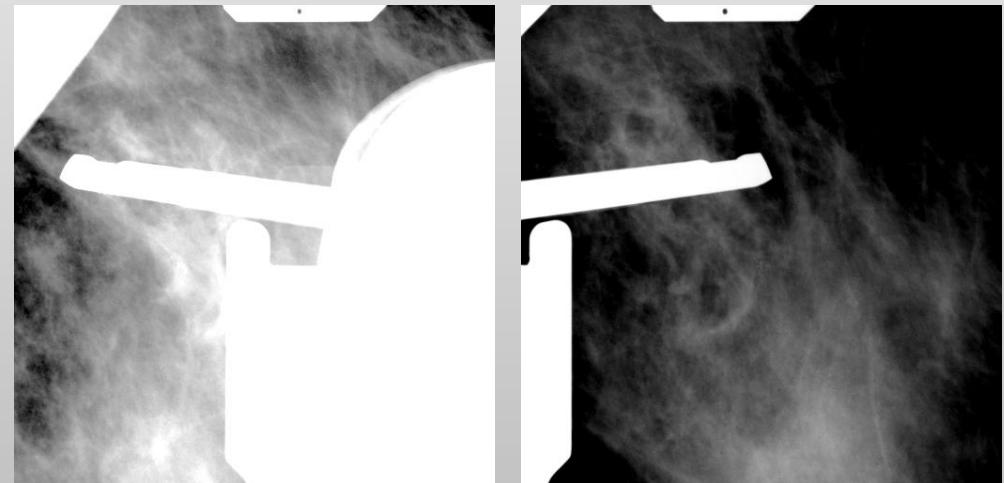
Stereo guidance

- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - **Post-fire stereo pair**
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- Specimen images

Pre-fire stereo pair



Post-fire stereo pair



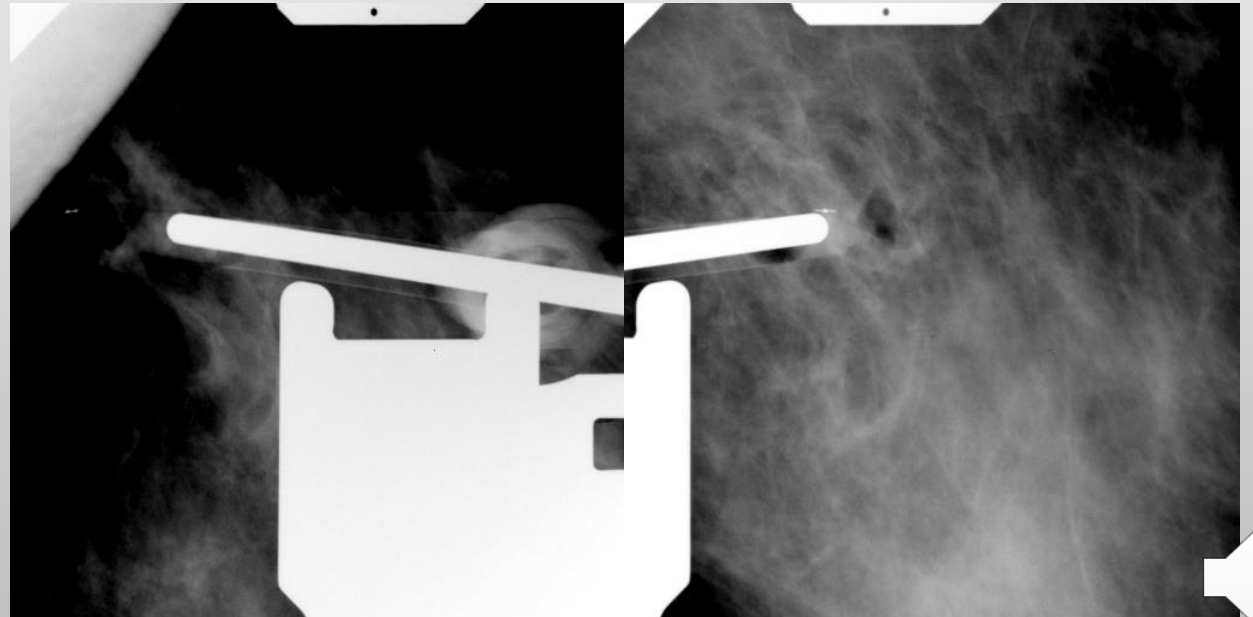
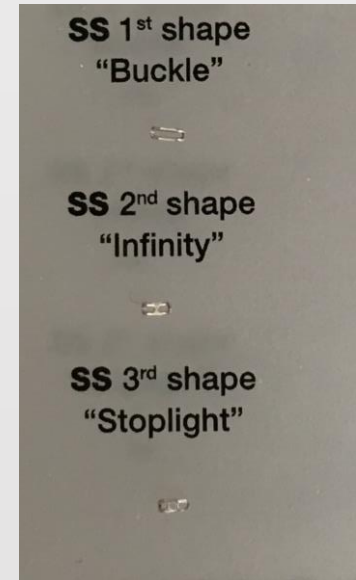
Lesion should “within” needle trough
If needle location is good, obtain samples



Imaging during the biopsy procedure

Stereo guidance

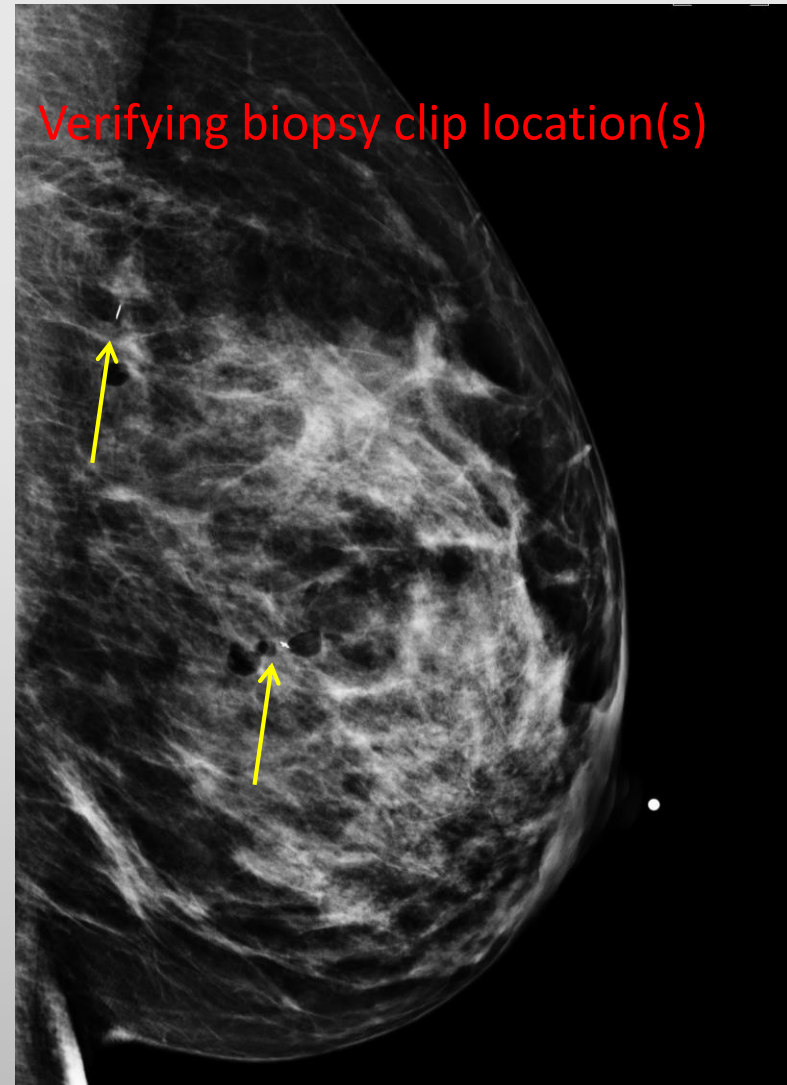
- Pre-procedure mammogram
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 - Stereo scout
 - +/- 15 degree stereo pair
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 - Pre-fire stereo pair
 - Post-fire stereo pair
- **Biopsy clip confirmation (stereo)**
- Post procedure mammogram
- Specimen images



Imaging during the biopsy procedure

Stereo guidance

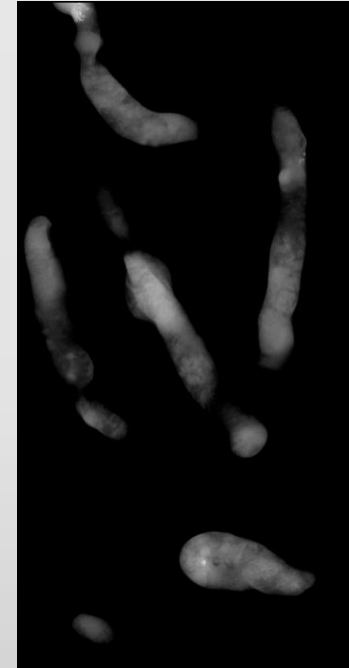
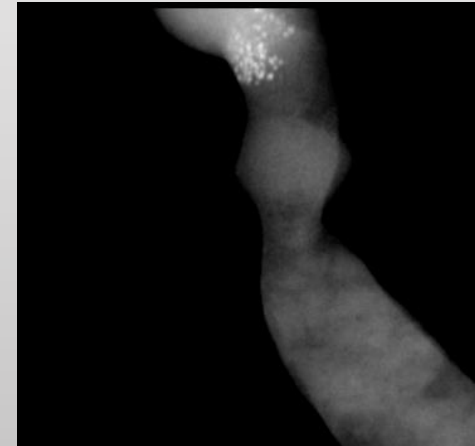
- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- **Post procedure mammogram**
- Specimen images



Imaging during the biopsy procedure

Stereo guidance

- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- **Specimen images**



Calcifications must be seen in tissue samples to confirm successful biopsy



Imaging during the biopsy procedure

Stereo guidance

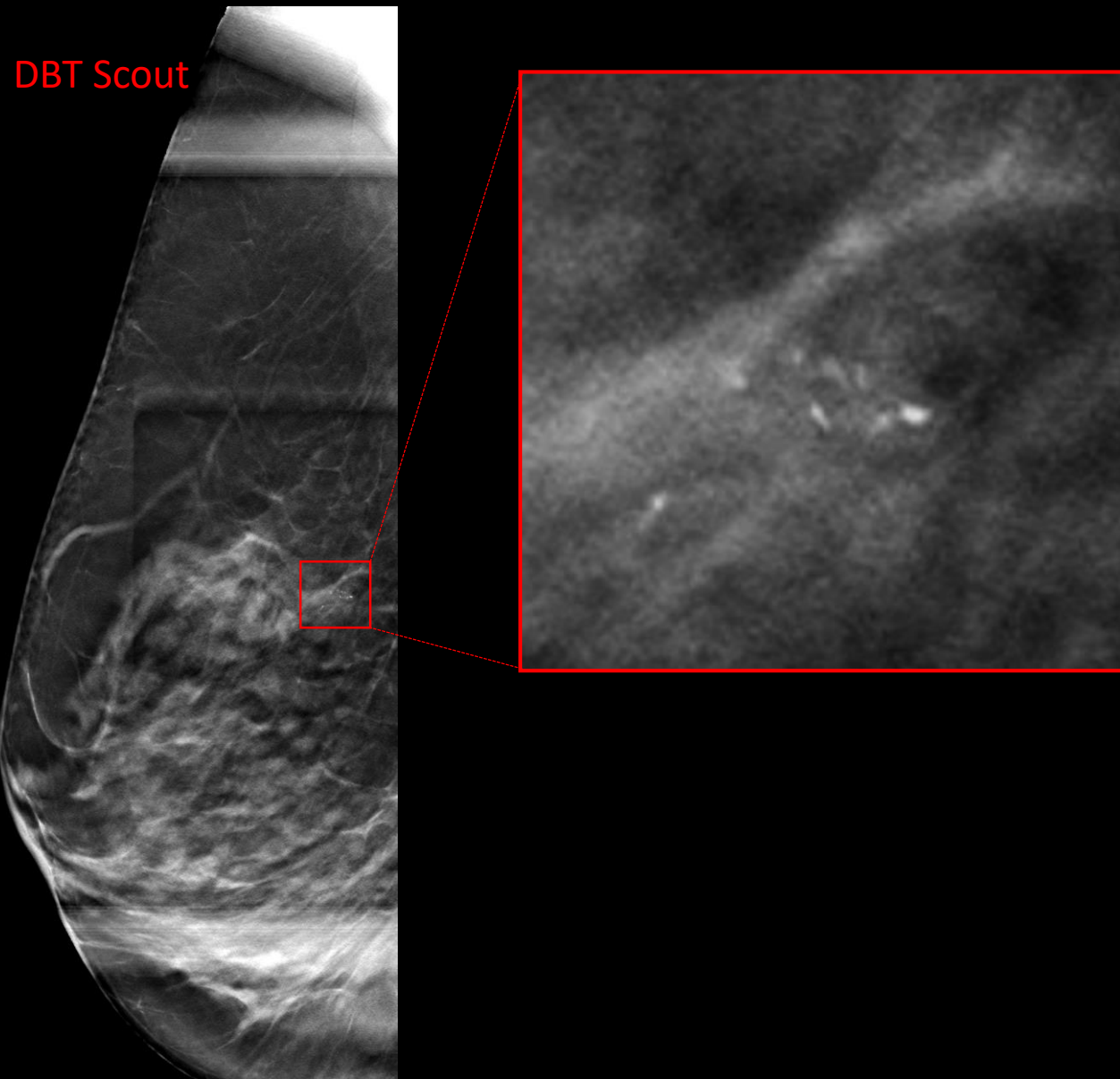
- Pre-procedure mammogram
- Lesion targeting
 - Stereo scout
 - +/- 15 degree stereo pair
- Tissue sampling
 - Pre-fire stereo pair
 - Post-fire stereo pair
- Biopsy clip confirmation (stereo)
- Post procedure mammogram
- Specimen images

DBT guidance

- **DBT** scout
- Pre-fire **DBT or stereo pair**
- Post-fire **DBT or stereo pair**
- Biopsy clip confirmation (**DBT**)

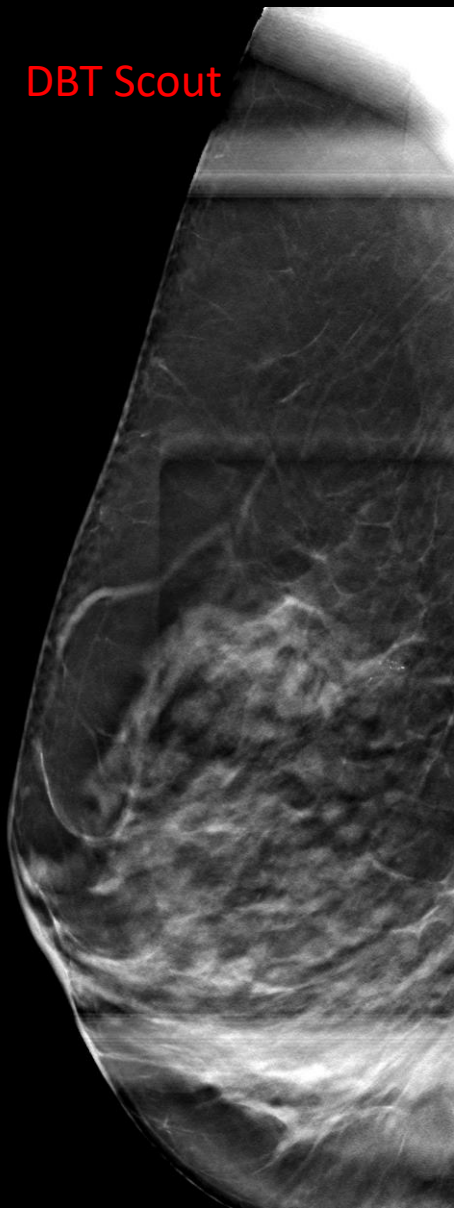


Case 1: DBT image guidance (DBT pre/postfire)

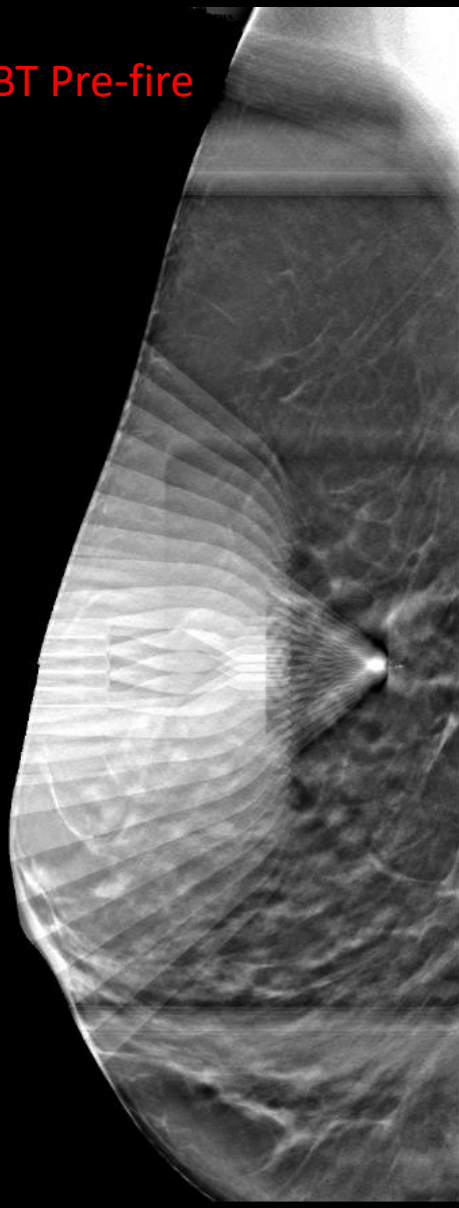


Case 1: DBT image guidance (DBT pre/postfire)

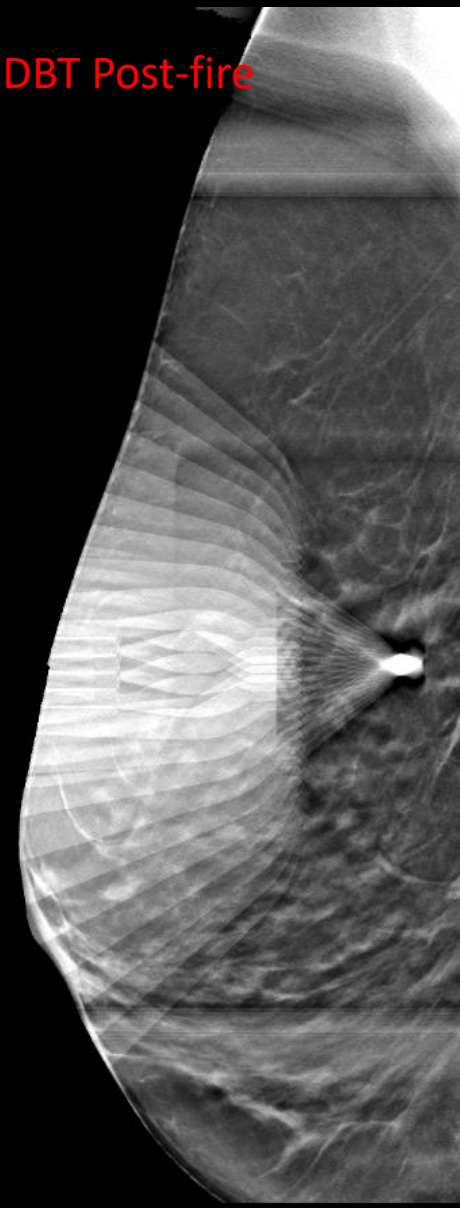
DBT Scout



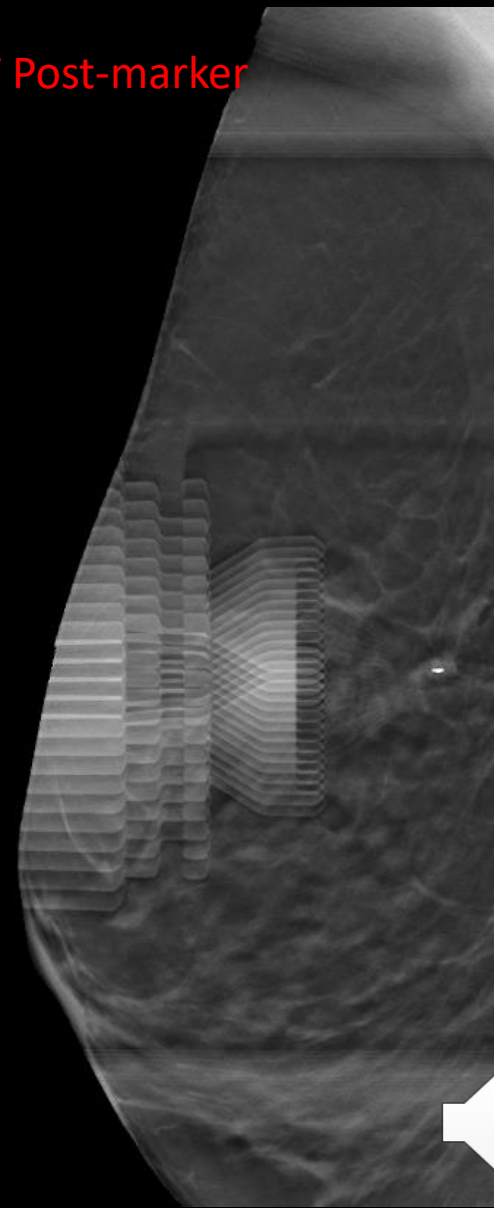
DBT Pre-fire



DBT Post-fire



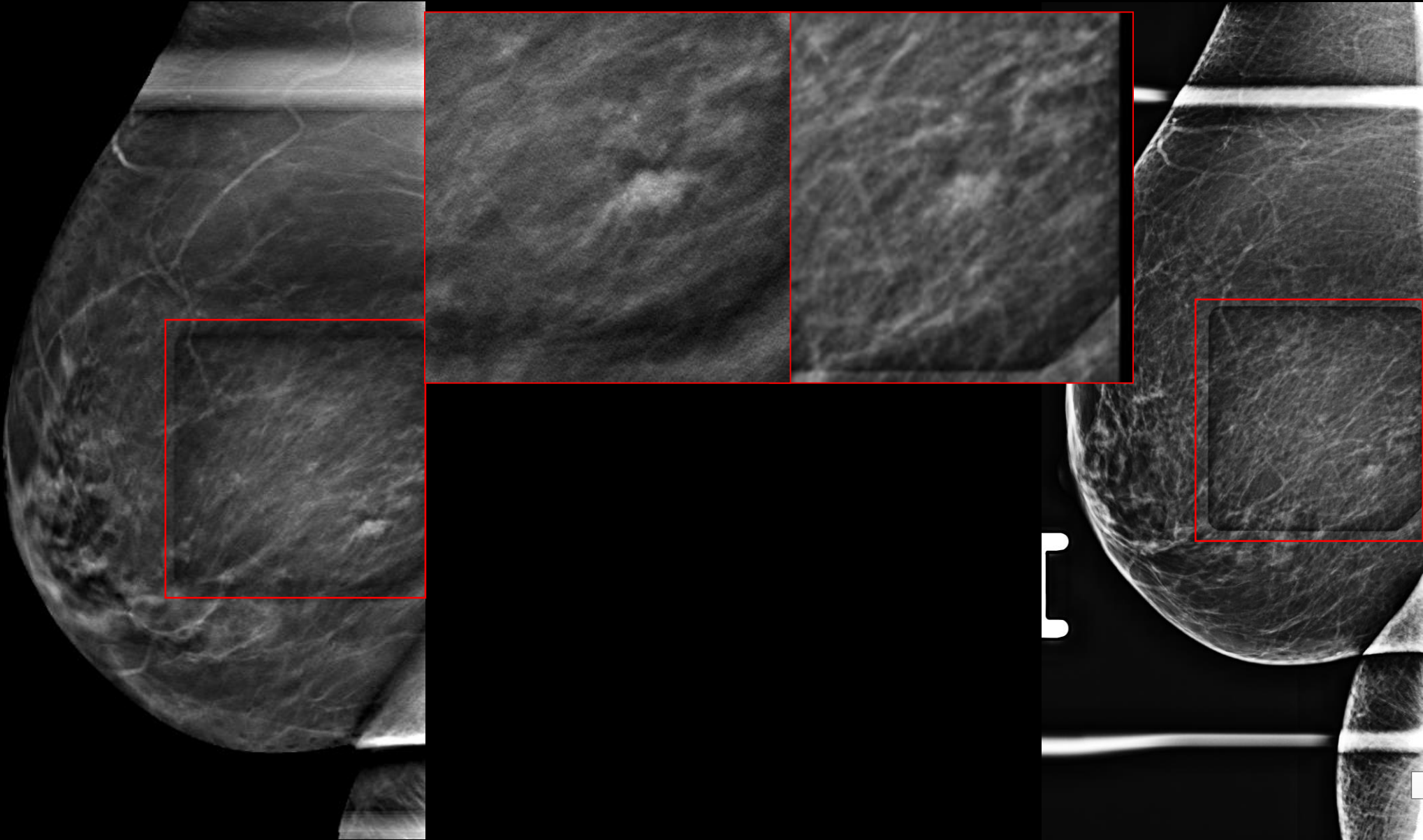
DBT Post-marker



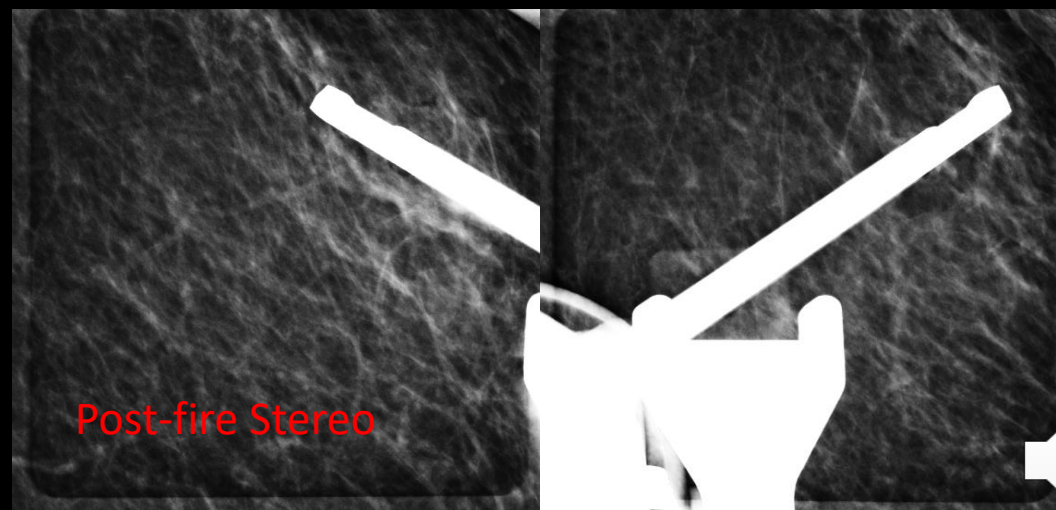
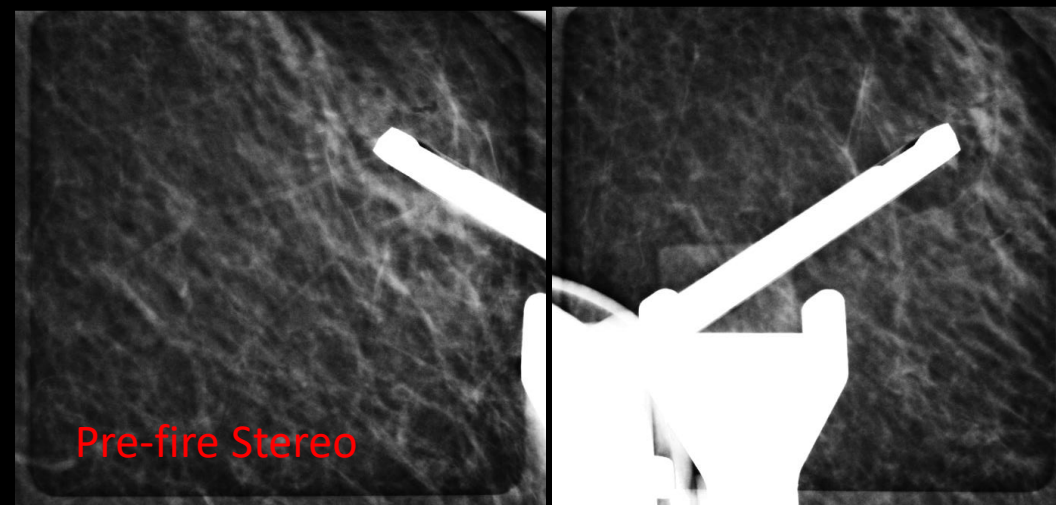
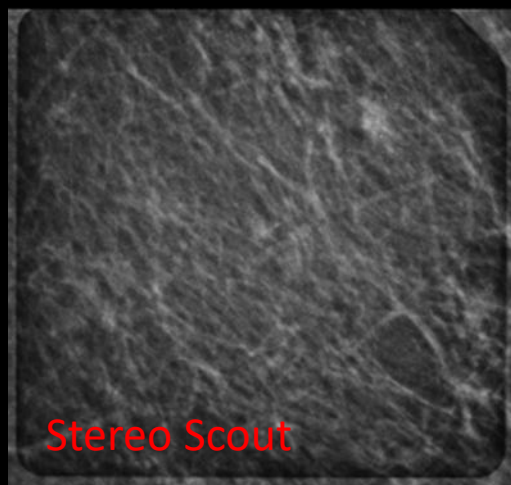
Case 2: DBT/Stereo image guidance

DBT Scout

Stereo Scout

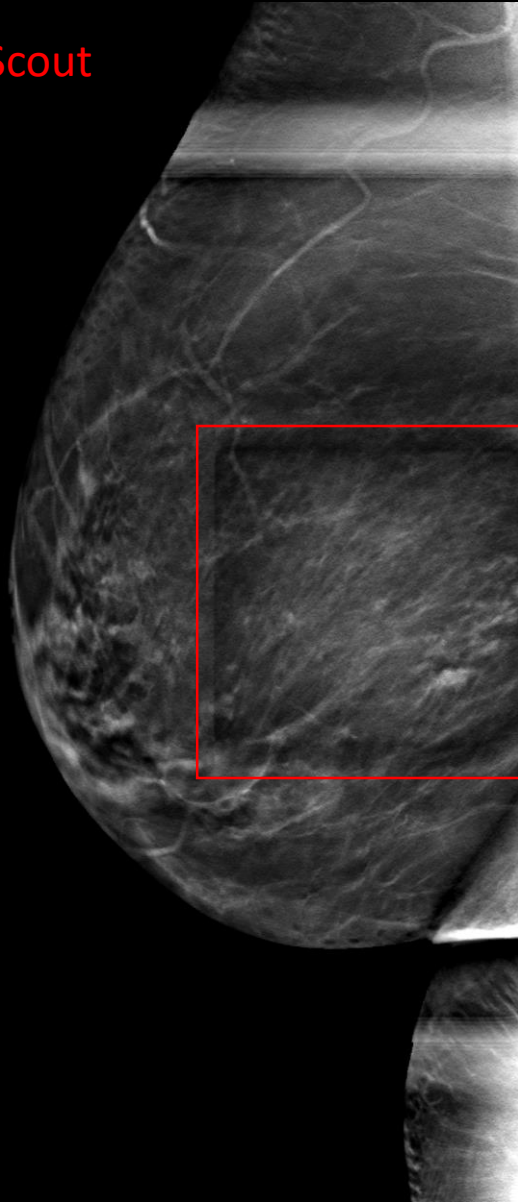


Case 2: DBT/Stereo image guidance

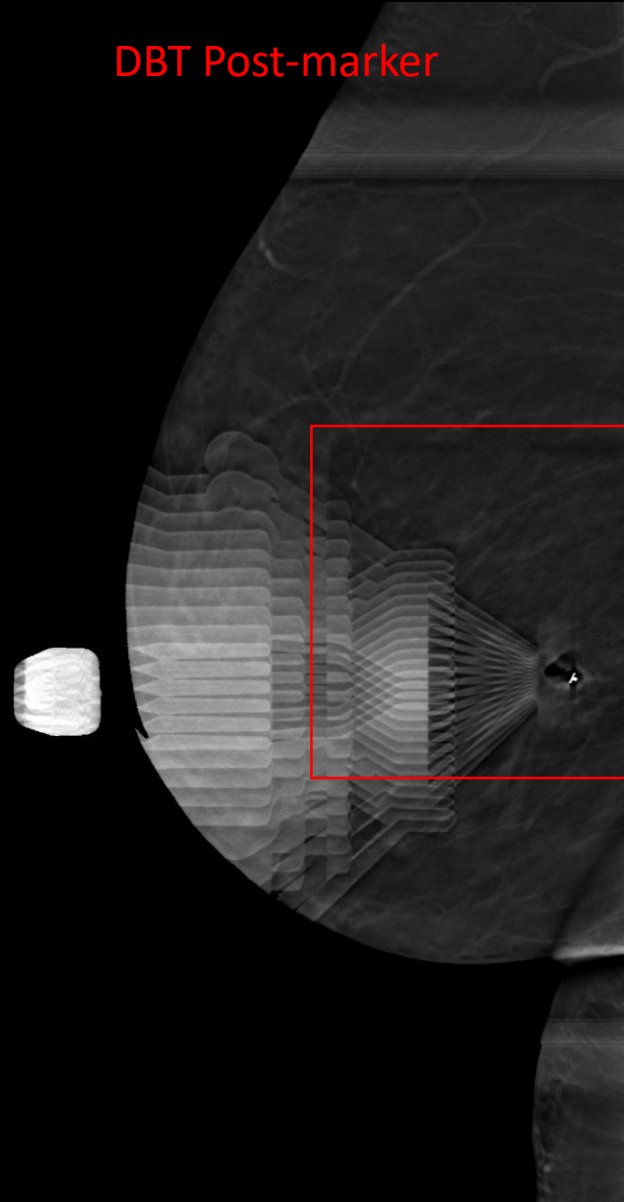


Case 2: DBT/Stereo image guidance

DBT Scout

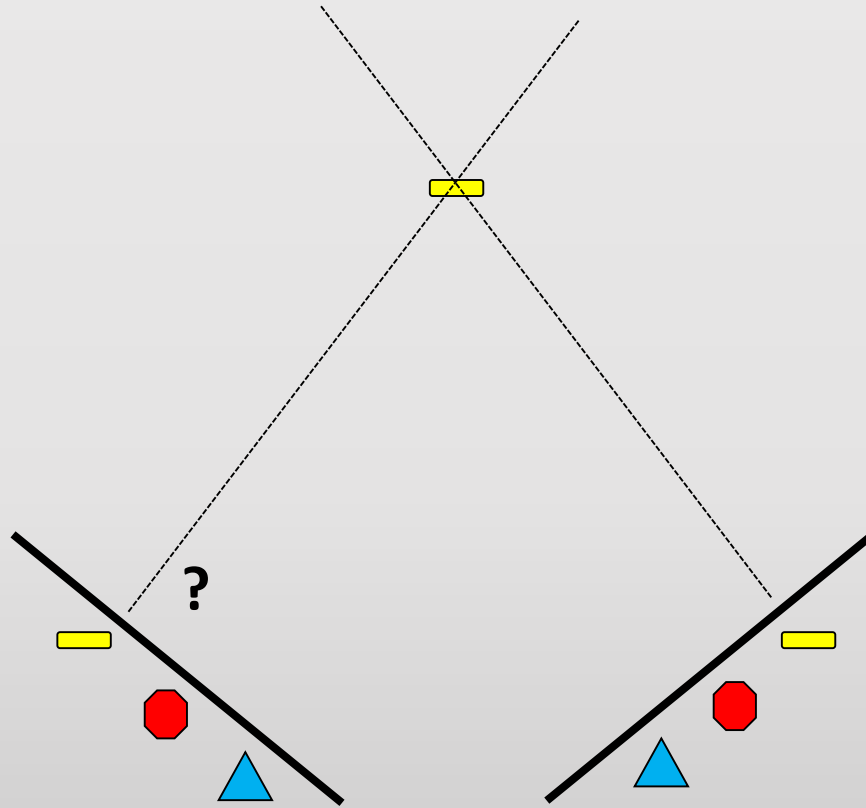


DBT Post-marker

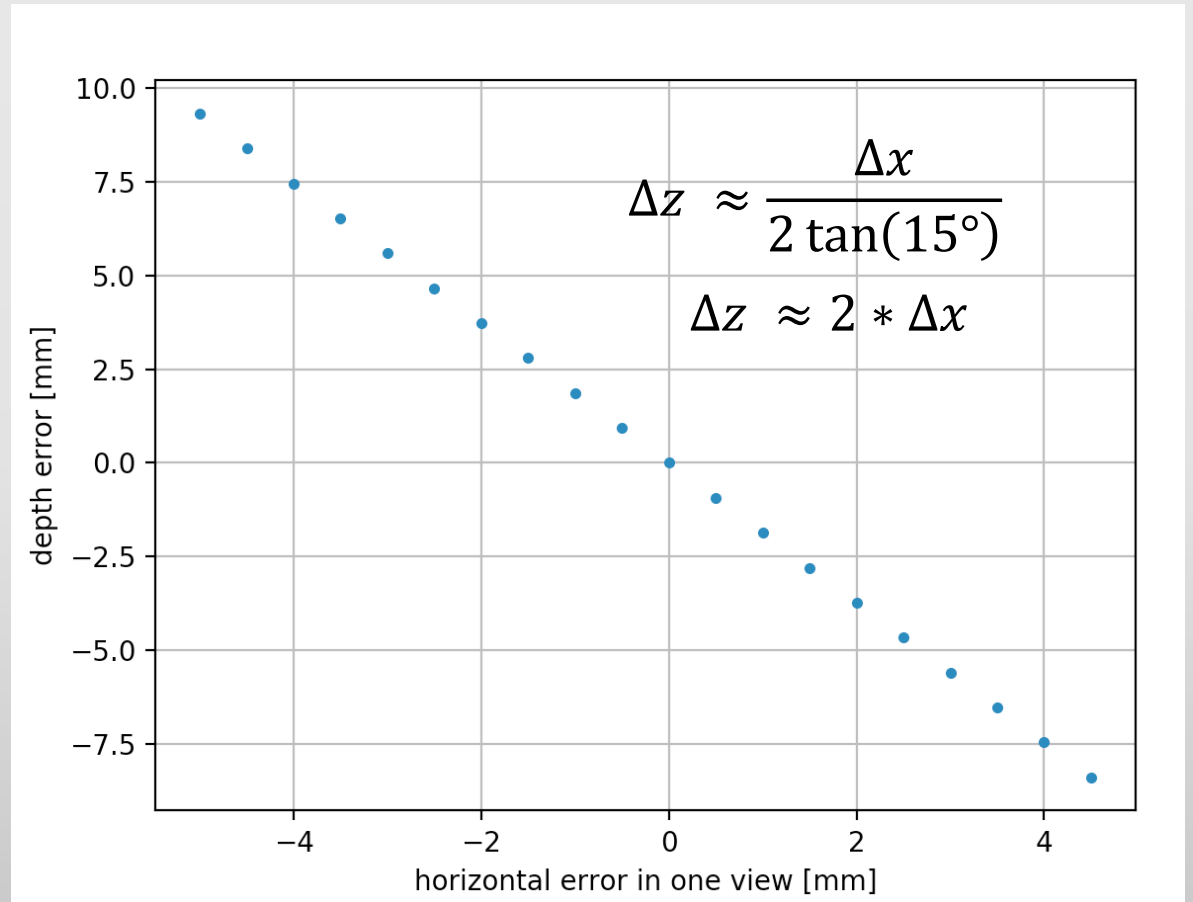
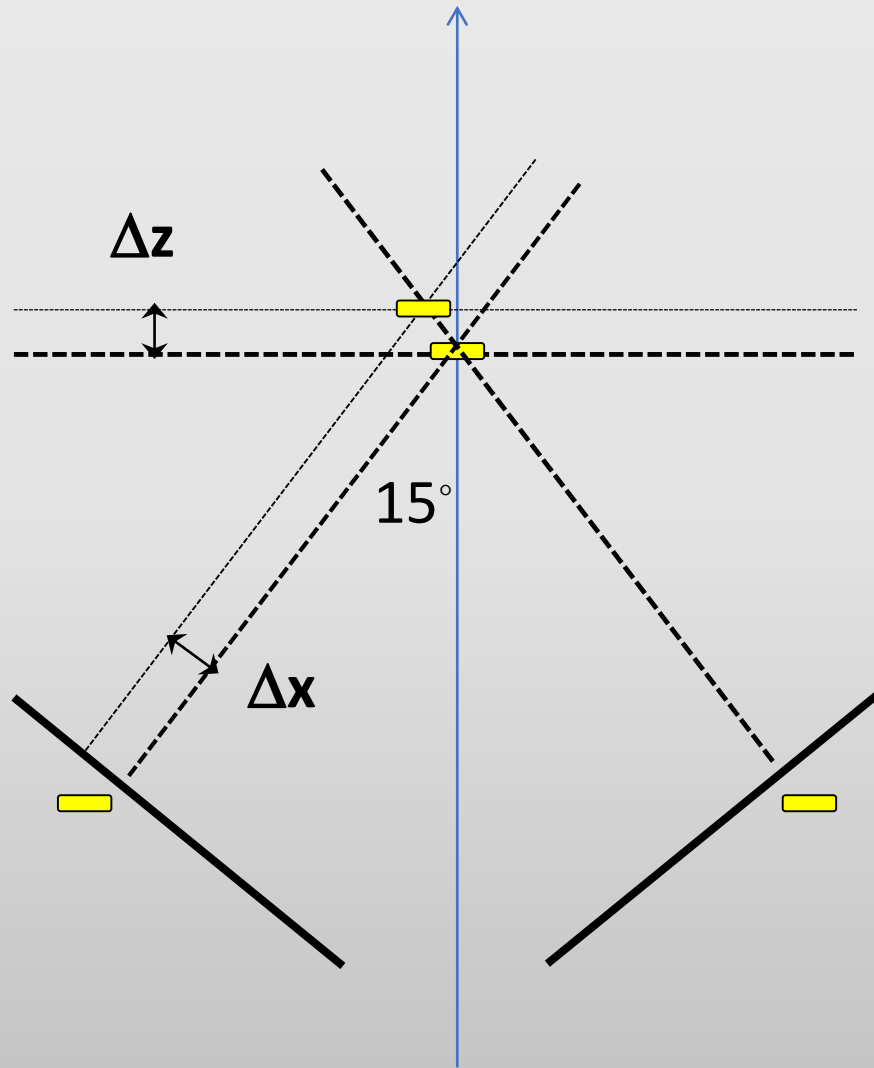


Pitfalls

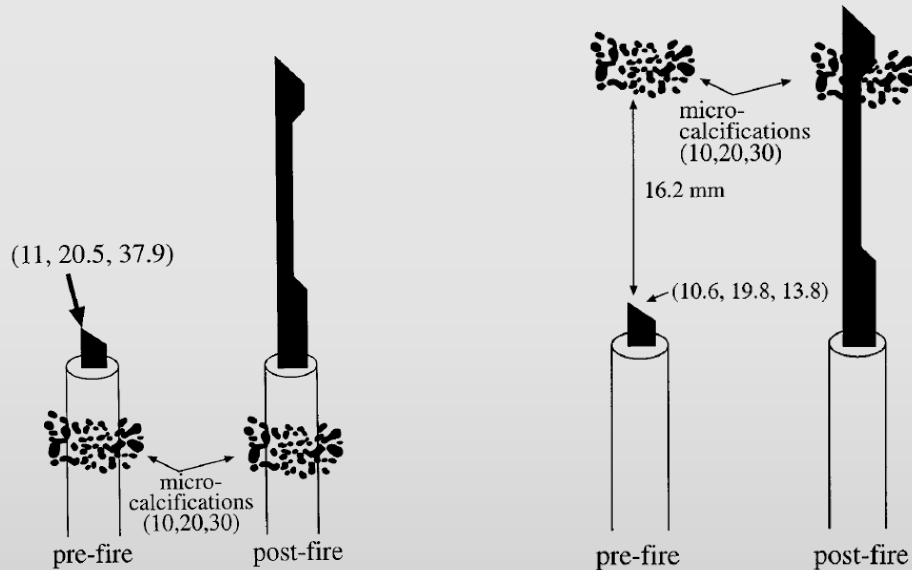
- Uncertainty



Uncertainty - Stereo

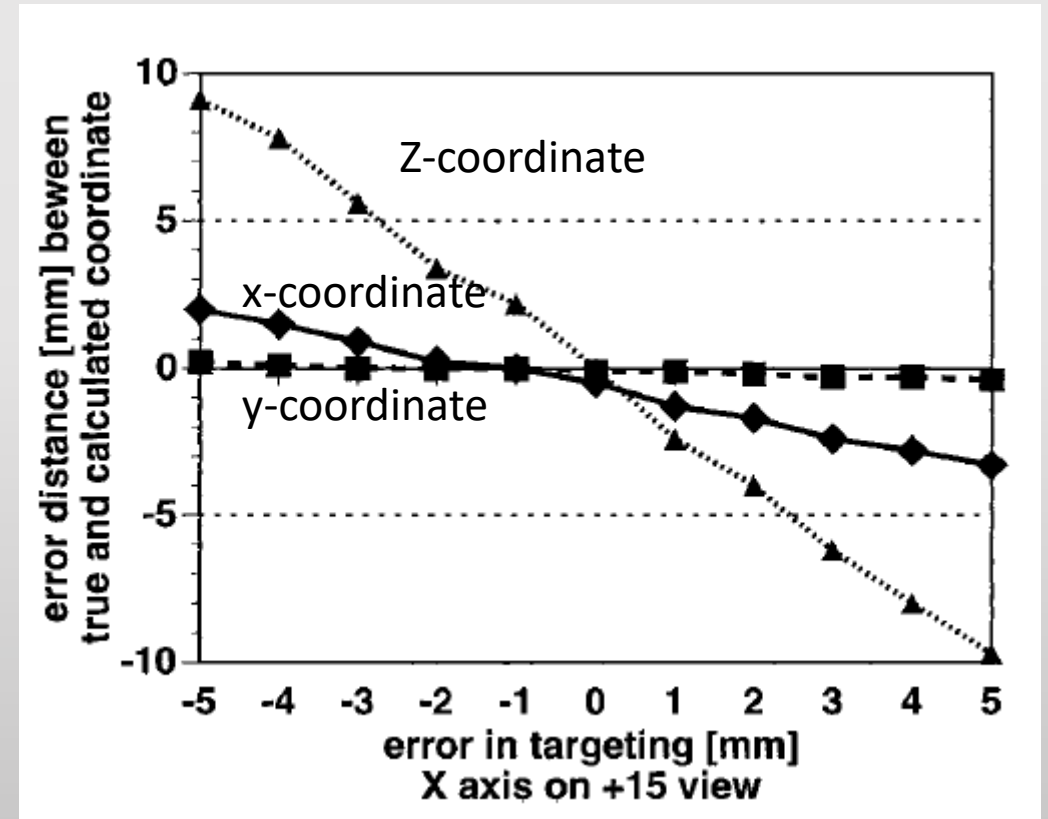


Error due to uncertainty



Lesion more shallow than
calculated
(+3/-3mm error on +15/-15
views)

Lesion deeper than
calculated
(-3/+3mm error on
+15/-15 views)



Error due to uncertainty

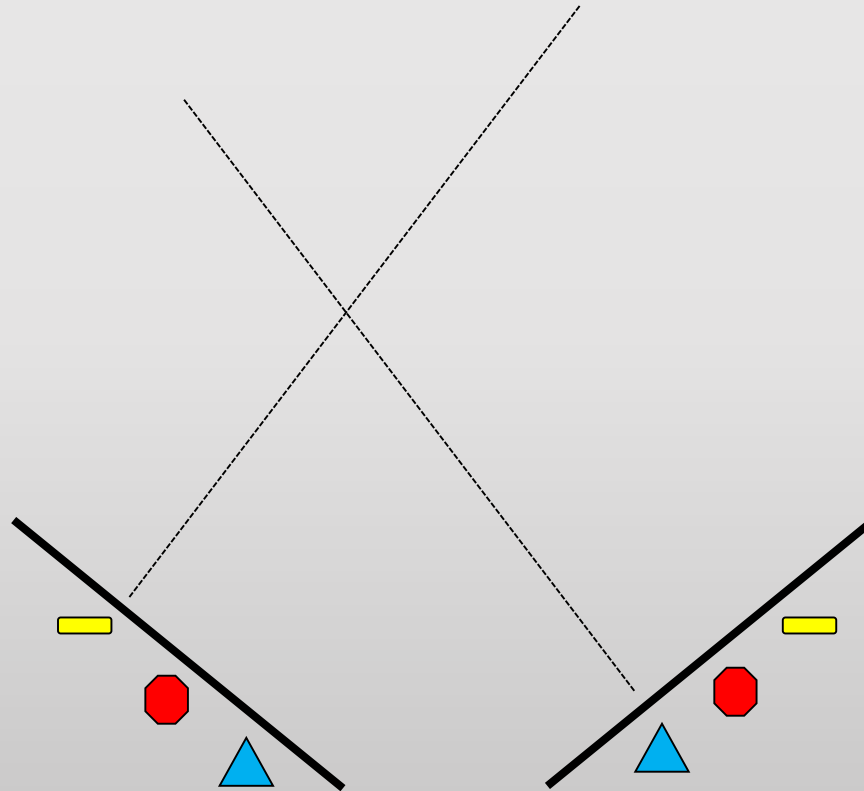
- Can affect targeting of small masses



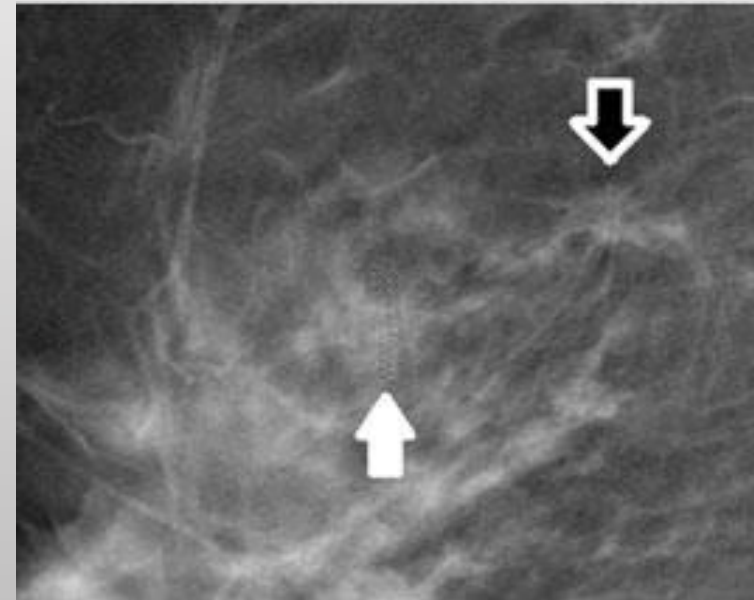
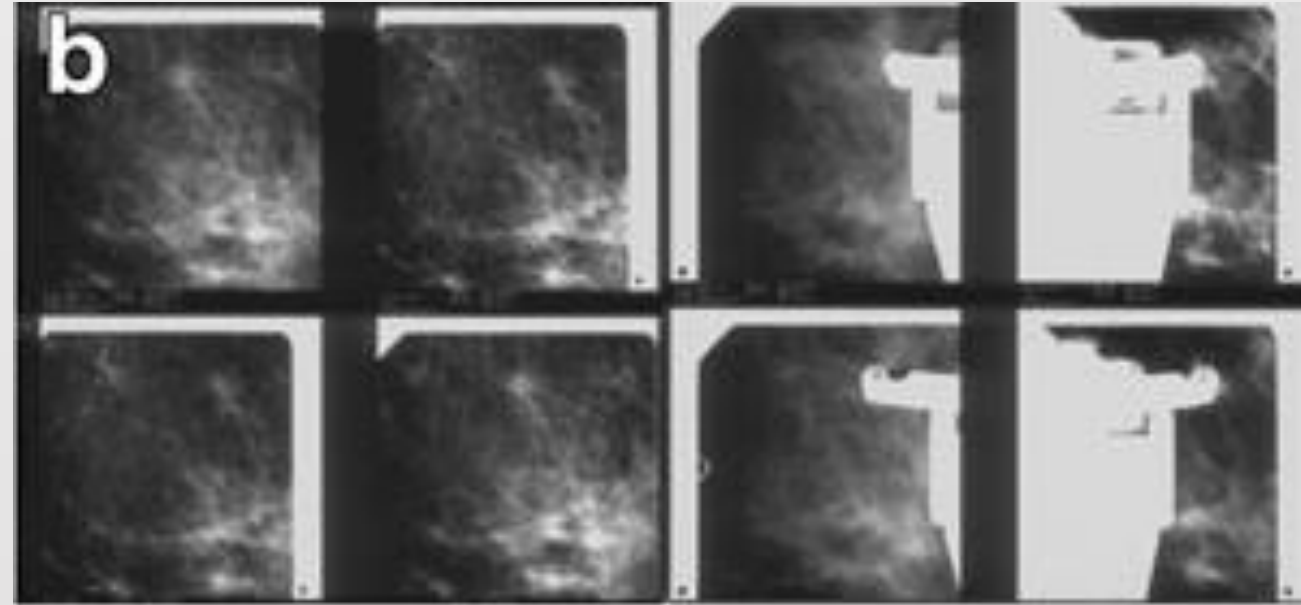
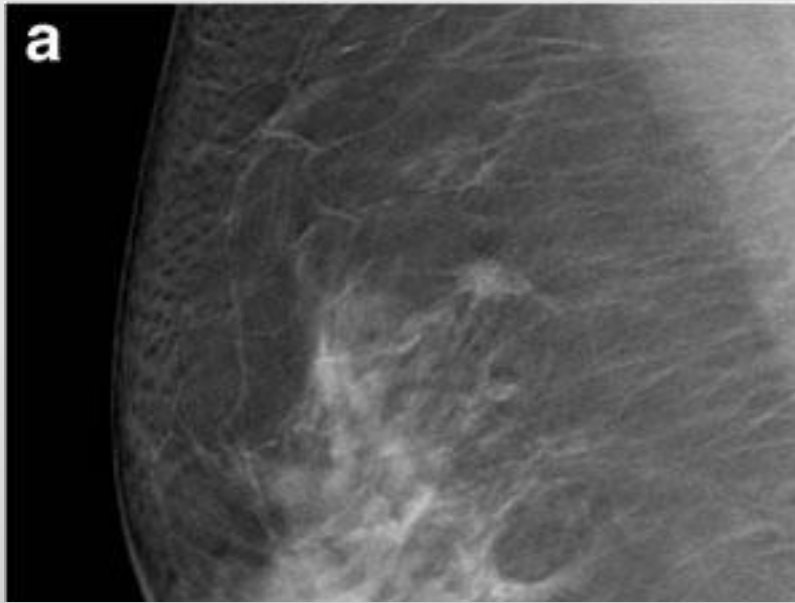
Pitfalls

Yellow & blue

- Uncertainty
- Erroneous measurement



Failed stereo localization

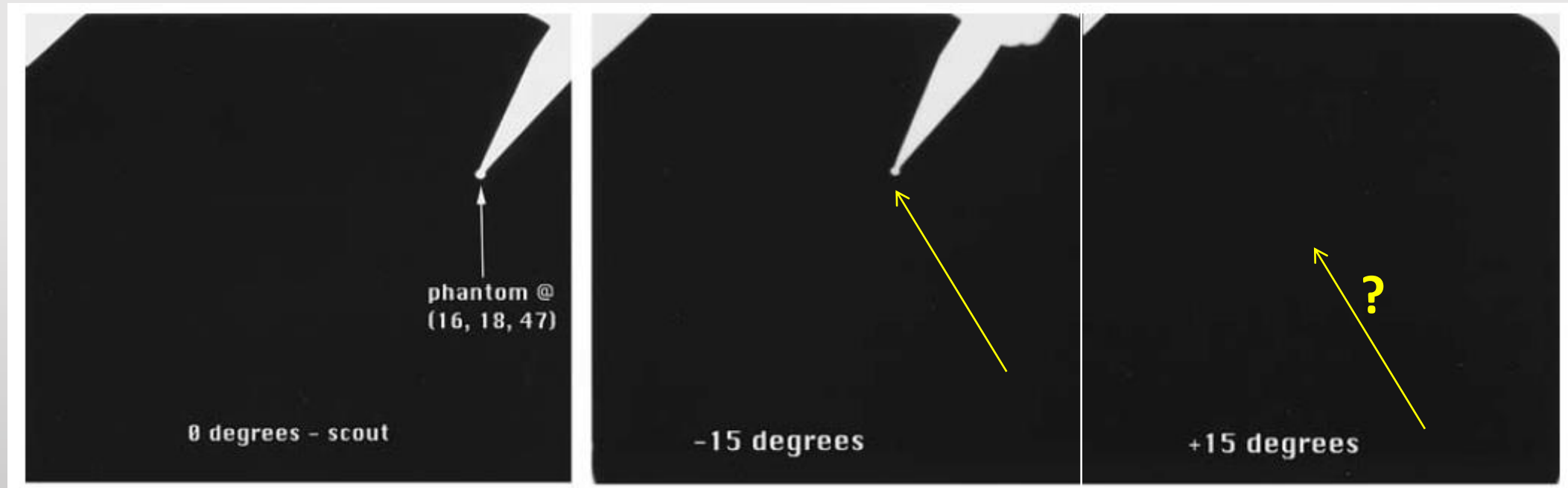


Pitfalls

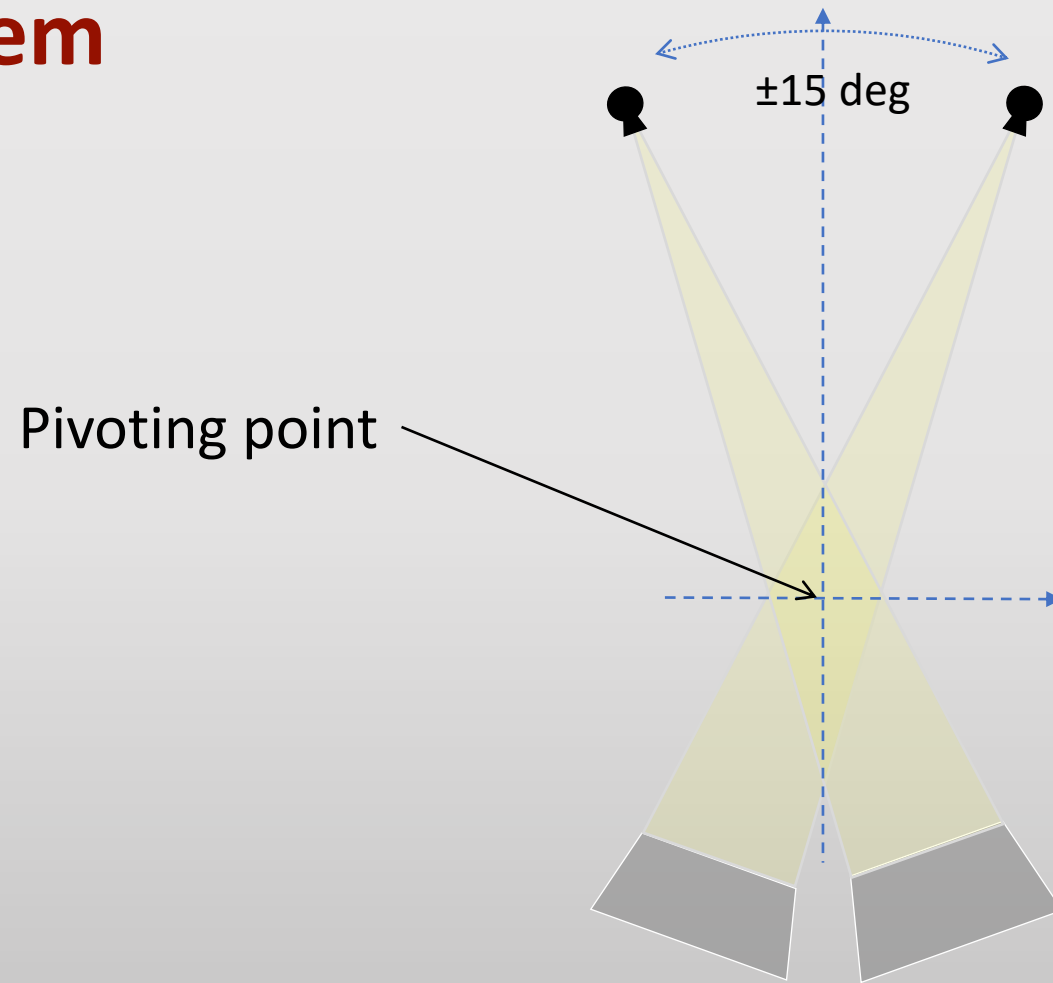
- Uncertainty
- Erroneous measurement
- Non-visualization of lesion due to positioning



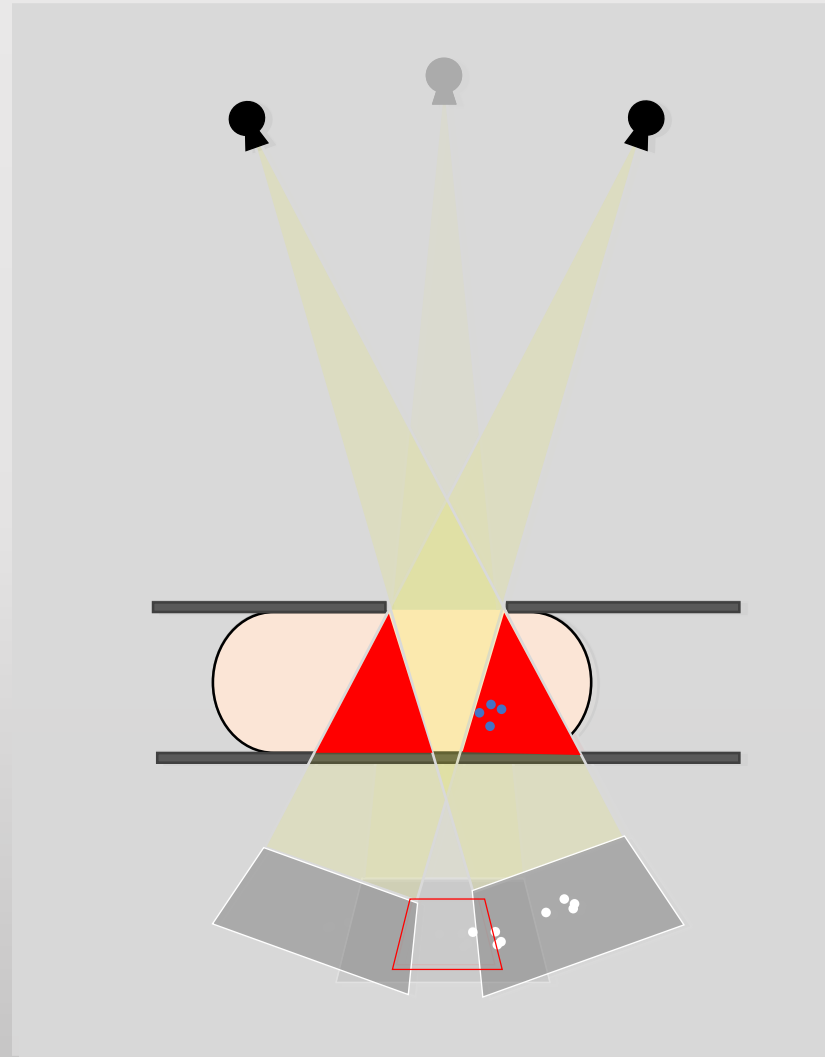
Non-visualization of lesions



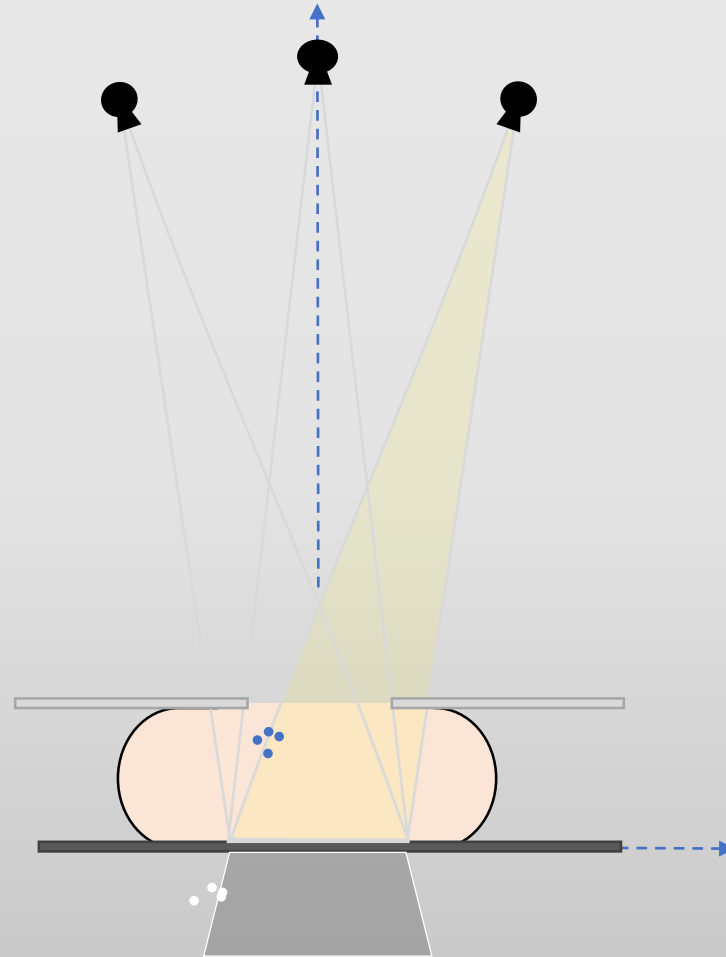
Stereo acquisition with rotating system

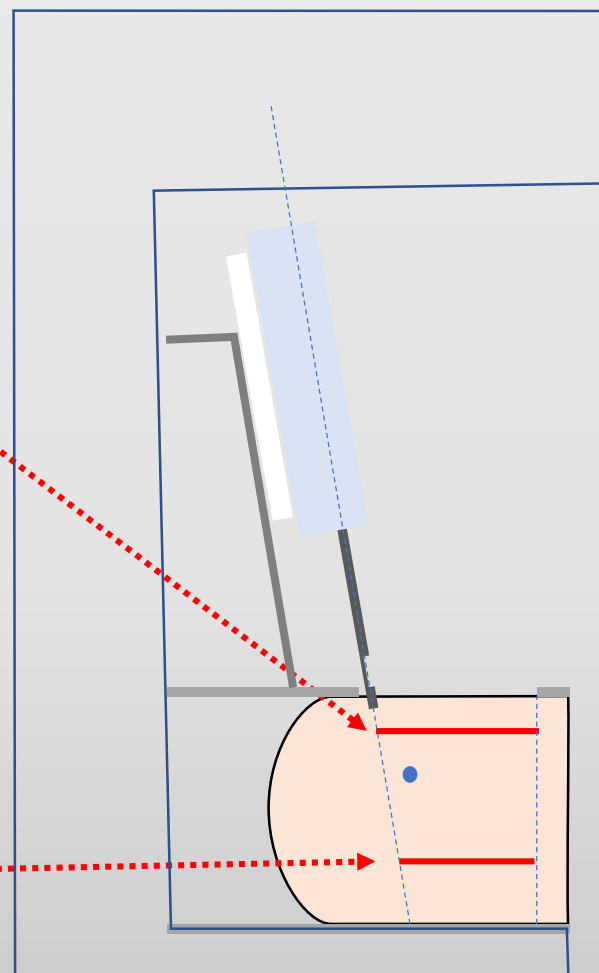
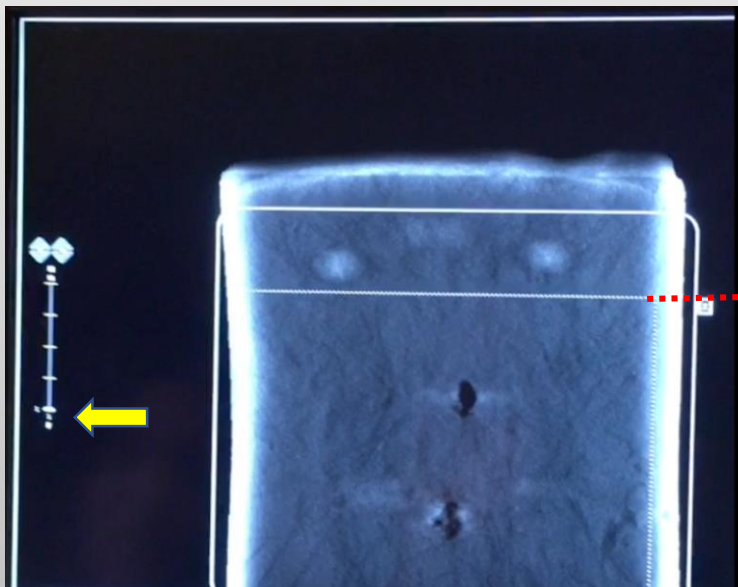
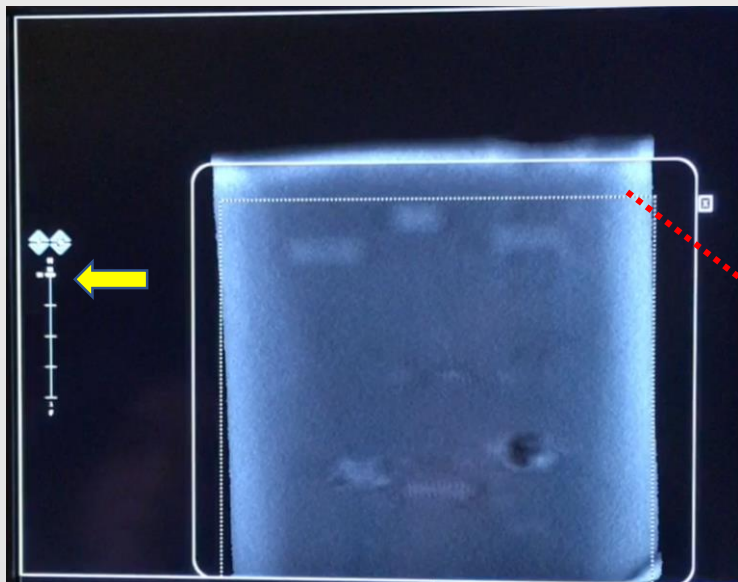


Deep lesion



Proximal lesion off-centered on scout





Potential pitfalls

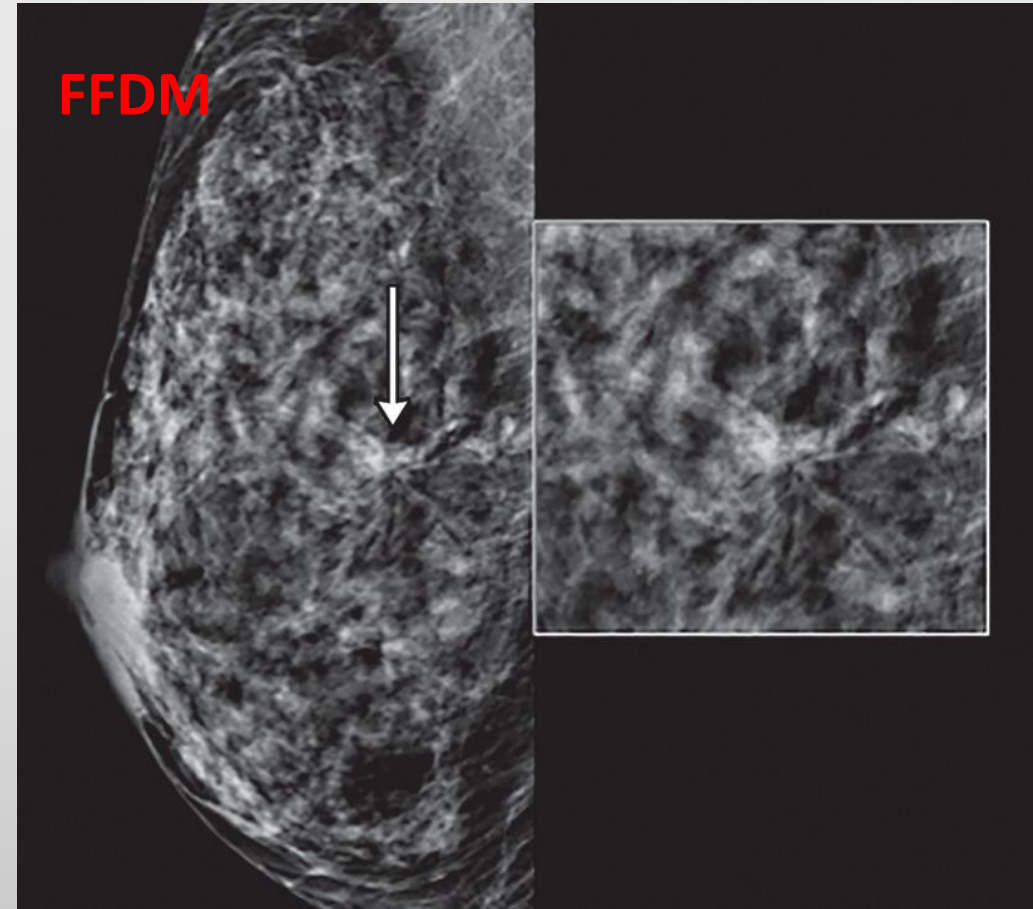
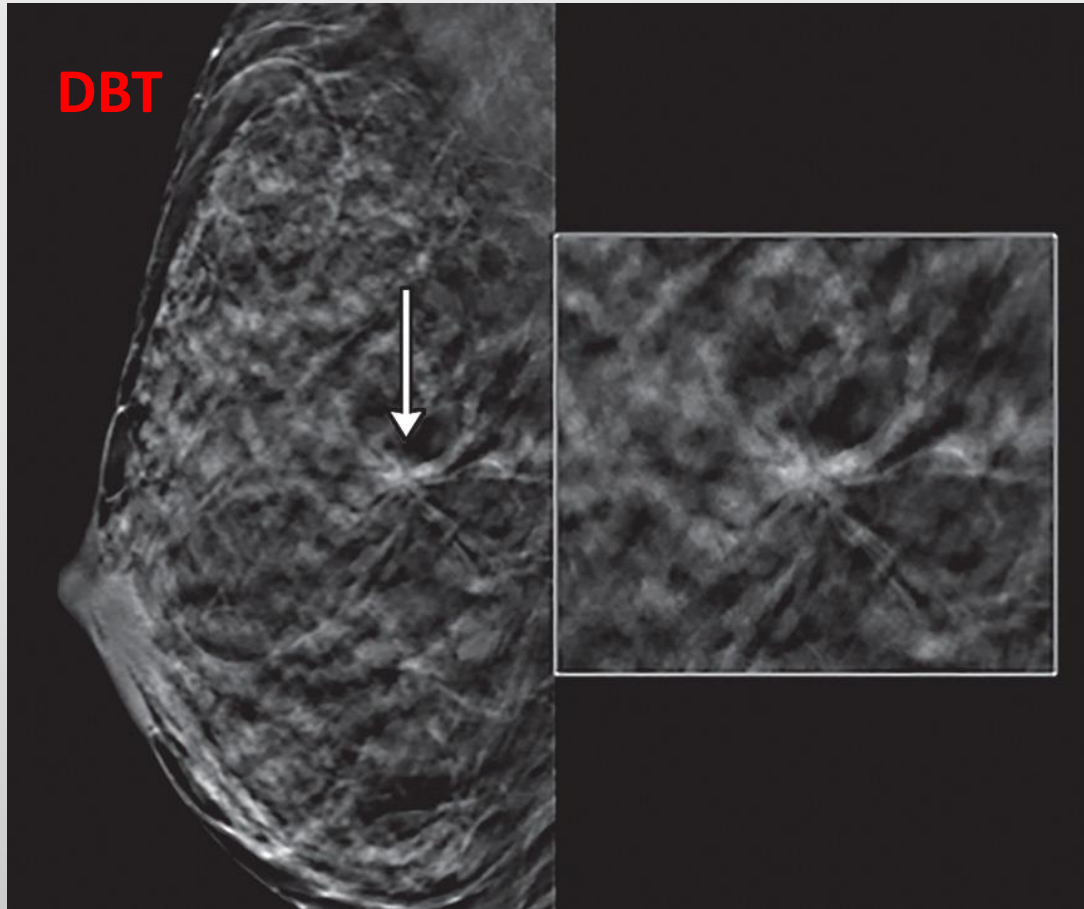
	Stereo imaging	DBT imaging
Targeting uncertainty	Significant depth uncertainty	N/A
Multiple lesions	Lesions might be missed if not marked correctly	N/A
Field-of-view limitations	More severe for rotating detector	Less severe (no significant detector rotation)



When to use DBT guidance?

- DBT-guidance used when lesion is seen on DBT only, particular architectural distortions





Summary & Conclusion

Both stereotactic and tomosynthesis imaging can be useful for biopsy guidance:

- DBT guidance allows biopsy of lesions that are only seen in tomosynthesis, such as architectural distortions
- Lesion targeting in the tomosynthesis scout eliminates depth uncertainty, and reduces the potential to mis-target lesions
- Tomosynthesis artifacts due to biopsy needle in pre/post-fire images are severe
 - Use stereo imaging if lesions are visualized
 - Lateral arm produces fewer artifacts
- Both DBT and stereo guidance are available as upright add-on and with prone biopsy tables



Acknowledgments

Deepa Sheth, MD

Kirti Kulkarni, MD

Morlie Wang, MD



Thank You!

