TOMOSYNTHESIS GUIDED BREAST BIOPSY

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LEARNING OBJECTIVES

- What is the difference between tomosynthesis guided breast biopsy compared with 2D stereotactic guided biopsy
- When and how do we decide which patients receive tomosynthesis guided biopsy compared to 2D stereotactic biopsy
- Advantages and disadvantages to tomosynthesis guided biopsy
- What advantages does the new prone tomosynthesis/2D table provide
- What is the medical physicists role with this modality

DISCLOSURES

- I have no disclosures to report
HISTORY OF TOMOSYNTHESIS

- Basic theoretical framework was provided by Ziedses des Plantes in the 1930's
- In 1972 Grant coined the term ‘tomosynthesis’ in a landmark paper that described simple tomosynthesis reconstruction
- In the 1970-1980's a number of variants of tomosynthesis were developed (i.e. ectomography and flash tomography)
- With the advent of spiral CT in the 1980's tomosynthesis research halted
- In the 1990's research using tomosynthesis for chest and breast imaging began

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HISTORY OF TOMOSYNTHESIS

- 1992 Christian, Niklason, LT, Niklason, LE and Kopans started looking at digital breast tomosynthesis (DBT) for breast imaging
- 2000 in collaboration with GE Healthcare the first studies were performed using DBT and a patent was granted
- 2011 FDA approved Hologic Selenia Dimensions 3D system for breast tomosynthesis
- 2013 FDA approved Hologic C-view imaging software for use with DBT to reconstruct 2-D images and Hologic Affirm Breast Biopsy Guidance System

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TOMOSYNTHESIS

- DBT is a 3D method of imaging that reduces tissue overlap seen in regular 2D mammography
- It is a form of limited-angle tomography
- Low-dose full field projection images of the breast are obtained from different angles with x-rays passing through the breast from different directions
- Reconstruction produces many 1 mm image slices

AJR2014, 202:299-308
TOMOSYNTHESIS

- In the screening patient, both the craniocaudal (CC) and mediolateral oblique (MLO) projections are acquired; however, additional projections may be obtained if warranted.
- The x-ray source moves in a single plane in an arc around the imaged breast.
- These projection images are then reconstructed into 1-mm-thick images for review. Filtered back projection (FBP) is the most commonly used method for reconstruction.

Advantages to using DBT:
- Decreases call back from screening.
- Better for dense breast tissue.
- Able to see architectural distortion and isodense masses better.
- Helps distinguish skin lesions without the use of tangential views.
- Helps localize a lesion for ultrasound or biopsy.
- Allows better visualization of mass margins so can go straight to ultrasound from screening call back.
TOMOSYNTHESIS

- Disadvantages to using DBT:
  - Longer scan time than 2D mammogram.
  - Increase radiation dose compared with 2D.
  - Not yet covered by all insurance companies.
  - Takes longer time to read.

TOMOSYNTHESIS VS. STEROTACTIC GUIDED BIOPSY – LESIONS BEST VISUALIZED

<table>
<thead>
<tr>
<th>Tomo Guided Biopsy</th>
<th>Stereotactic Guided Biopsy</th>
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<tbody>
<tr>
<td>Architectural Distortion</td>
<td>Calcifications</td>
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<tr>
<td>Isodense or low density lesions.</td>
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<td>Single view findings.</td>
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TOMOSYNTHESIS VS. STEROTACTIC GUIDED BIOPSY - ADVANTAGES

<table>
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<tr>
<th>Tomo Guided Biopsy</th>
<th>Stereotactic Guided Biopsy</th>
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<tr>
<td>Can be done upright or prone position if you have both available.</td>
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<td>Larger field of view 18 x 24 cm.</td>
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<td>Shorter biopsy times (&lt;9 vs 29 minutes).</td>
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<td>3D imaging for better and more accurate targeting.</td>
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<td>Biopsy equipment is easily installed and removed from a mammogram machine.</td>
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<td>Less exposure needed.</td>
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<td>Patients who are over the weight limit for the prone table.</td>
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<td>Better ability to make adjustments due to better visualization of the lesion and through and needle tip.</td>
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| Stereotactic Guided Biopsy |  |
|---------------------------|  |
| Can be done upright or prone position if you have both available. |  |
| If patient does not want to see the needle prone positioning allows for them not to. |  |
| Better to see calcifications. |  |
| Less vasovagal episodes. |  |
TOMOSYNTHESIS VS. STEROTACTIC GUIDED BIOPSY – LIMITATIONS

**Tomo Guided Biopsy**
- Vasovagal episodes.
- If only have upright biopsy system more difficult to reach very posterior lesions.
- A mammogram machine is need so won't be able to do mammograms on it when biopsy is occurring.

**Stereotactic Guided Biopsy**
- Difficult to accurately biopsy distortions, isodense masses and one view findings.
- Smaller FOV.
- Longer time for biopsy.
- In only have prone table cannot biopsy patients over weight limit or those who cannot lie on their stomach.
- Posterior lesion accessibility

TOMOSYNTHESIS GUIDED BIOPSY

- Use a 7G – 11G vacuum biopsy needle.
- Comes in standard size (20 mm trough), petite (12 mm trough) and Non-firing (12 mm trough).
- Tomosynthesis guidance helps overcome technical challenges previously seen in stereotactic biopsy:
  - Superficial lesion
  - Deep or very superior lesion
TOMOSYNTHESIS GUIDED BIOPSY

• The TVAB system is mounted onto the mammogram equipment’s C-arm and locked into place.

TOMOSYNTHESIS GUIDED BIOPSY

• After consent is given and a time out is performed the patient is positioned and a scout tomosynthesis view is performed to acquire the target.

TOMOSYNTHESIS GUIDED BIOPSY

• The target is marked and the coordinates are sent to the TVAB system.
TOMOSYNTHESIS GUIDED BIOPSY

- The needle is then attached to the system and the needle is homed and then targeted to the appropriate coordinates.

TOMOSYNTHESIS GUIDED BIOPSY

- The patient’s skin is cleaned and lidocaine is injected into the skin and subcutaneous tissues. Then the needle is advanced along the z-axis to the appropriate depth.

TOMOSYNTHESIS GUIDED BIOPSY

- A second set of tomosynthesis images is performed to ensure accurate targeting.
TOMOSYNTHESIS GUIDED BIOPSY

• Biopsy is then performed taking 6-12 cores and a clip is then placed.

TOMOSYNTHESIS GUIDED BIOPSY

• A tomosynthesis is acquired to ensure clip deployment and appropriate placement.

TOMOSYNTHESIS GUIDED BIOPSY

• Pressure is held for 10 minutes to stop bleeding and a post biopsy 2D CC and ML mammogram is performed.
NEW PRONE 2D/3D TABLE

- Enables biopsy of lesions only visible with tomosynthesis.
- Amorphous Selenium Detector (same detector technology as the upright).
- X-ray translucent paddles for better visualization of breast tissue surrounding biopsy window.
- 6.5 times larger FOV – 14.3 cm X 11.7 cm.
- Fast one-click targeting.
- True 360 degree access – Lateral arm (no need to take patient out of compression moving from standard approach to lateral approach).
- Clear paddles (easier to see landmarks).

Visualize challenging subtle masses and faint calcifications including those only visible under tomosynthesis imaging.
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