Biopsy Procedures and Margin Assessment: The role of imaging during breast cancer diagnosis and surgery

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## Breast biopsy ~ 1990

Image-based target localization in the breast becomes available

 enables use of a biopsy gun for breast biopsy





-> stereotactic breast biopsy



SH Parker et al, Stereotactic Breast Biopsy with a Biopsy Gun. Radiology 1990; 176:741-747.

## Imaging during the biopsy procedure

• Pre-procedure mammogram





### **DBT/Stereo image guidance**

#### DBT Scout



DBT Scout



Stereo Scout



Lesion is targeted in DBT scout



### **DBT/Stereo image guidance**

#### **DBT Scout**



#### Pre-fire Stereo



#### Post-fire Stereo





### **DBT/Stereo image guidance**

#### **DBT Scout**



#### DBT Post-marker





### **DBT image guidance (DBT pre/postfire)**





### **DBT image guidance (DBT pre/postfire)**



#### **DBT Post-marker**





### **Biopsy imaging guidance:**

Verification of core specimen samples



Calcifications must be seen in tissue samples to confirm successful biopsy





## **Biopsy imaging guidance**

- Stereotactic biopsy most common (52%) for nonpalpable tumors
- Reasons for excisional biopsy (2006):
  - Too faint, too superficial, to posterior(5%)
  - Patient preference (5%)
  - Small (<1cm) or superficial, easier to excise (4%)



D. R. Lannin, T Ponn, L. Andrejeva, L. Philpotts, Should all breast cancers be diagnosed by needle biopsy? The American Journal of Surgery 192 (2006) 450–454





## Breast cancer surgery

- Breast-conserving surgery (BCS):
  - Preferred method of treatment for early stage and uni-focal breast cancer  $^{\ast}$
  - The goal of breast-conserving surgery (BCS) is to excise the tumor with negative margins while achieving satisfactory cosmesis<sup>\*</sup>
- Breast-conserving treatment (BCT):
  - BCS + radiation therapy



\*Reyna C, DeSnyder SM. Intraoperative margin assessment in breast cancer management. *Surg Oncol Clin N Am*. 2018;27(1):155-165.

## Pre-and intra-operative imaging

Tumor staging (lesion size)

• MRI

Lesion localization

- Needle (wire) localization
- Radioactive seed localization

Determining whether localization and excision were successful

• Lumpectomy specimen imaging



### MRI staging: Tumor extent, multi-focality





## Wire localization: Procedure

#### "Kopans needle"



Development of Wire Localization for Occult Breast Lesions: Boston Remembrances. F. M. Hall, D. B. Kopans, N. L. Sadowsky, and M. J. Homer. Radiology 2013 268:3, 622-627



Lesions identified in alphanumeric grid

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Development of Wire Localization for Occult Breast Lesions: Boston Remembrances. F. M. Hall, D. B. Kopans, N. L. Sadowsky, and M. J. Homer. Radiology 2013 268:3, 622-627

## Radioactive seed localization

• Performed under ultrasound guidance





# Orthogonal digital specimen radiography:

- Verification that clips and wires are within specimen
- Margin verification

#### Wire localization





#### Seed localization







## Seed vs. wire localizations

 Several studies performed, no difference in margin status between both procedures

Murphy JO, Moo TA, King TA, et al. Radioactive seed localization compared to wire localization in breast-conserving surgery: initial 6-month experience. *Ann Surg Oncol*. 2013;20(13):4121-4127. doi:10.1245/s10434-013-3166-4

Rarick J, Kimler BF, Tawfik O. Comparison of margin status and lesional size between radioactive seed localized vs conventional wire localized breast lumpectomy specimens. *Ann Diagn Pathol*. 2016;21:47-52. doi:10.1016/j.anndiagpath.2016.01.003



### Lumpectomy specimen margins

Conservation of healthy breast tissue, improved cosmetic outcome



Removal of all cancer, minimize chance for recurrence

Re-excision required if positive margins are found at final pathology

Goal: 10% (American Society of Breast Surgeons)

#### **Reported re-excision rates: 10-50%**



Reyna C, DeSnyder SM. Intraoperative margin assessment in breast cancer management. *Surg Oncol Clin N Am*. 2018;27(1):155-165.

## Margin assessment can we do better?

- Improved margin assessment with intra-operative 3D imaging
- Active area of research, novel devices are coming to market





Kulkarni SA, Kulkarni K, Schacht D, et al. High-resolution full-3D specimen imaging for lumpectomy margin assessment in breast cancer. *Ann Surg Oncol*. 2021;28(10):5513-5524.

Park KU, Kuerer HM, Rauch GM, et al. Digital breast tomosynthesis for intraoperative margin assessment during breast-conserving surgery. Ann Surg Oncol. 2019;26:1720–8.

St John ER, Al-Khudairi R, Ashrafian H, et al. Diagnostic accuracy of intraoperative techniques for margin assessment in breast cancer surgery: a meta-analysis. Ann Surg. 2017;265:300–10.

## Summary

- Imaging plays an important role during work-up of breast imaging findings
  - Biopsy guidance
  - Localization for surgical excision
  - Margin assessment of lumpectomy specimen
- Novel imaging systems are being developed to enable margin assessment in the operating suite during surgery

