Breast tomosynthesis
Clinical cases:
benefits and practical considerations

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• 60 year-old-woman
• Left conservative treatment 10 years ago
• Annual follow-up
Cranio-caudal digital mammography 2D

Cranio-caudal spot compression

LCC

IDC

Stable scar

"scar" seems effaced
3D Spiculated mass Biopsy: IDC

Cranio-caudal tomosynthesis 3D
Conclusions (1): 3D versus 2D

• Some cancers are effaced on conventional spot compression
  (Roth R. Radiographics 2014)

• Detection rates were:
  6.1 per 1000 examinations for mammography 2D alone
  8.0 per 1000 examinations for 2D plus tomosynthesis
  27% increase, \( P = .001 \) (Skaane P. Radiology 2013)

• Twenty-four of the 29 additional cancers detected under the 2D+3D mode were node-negative invasive cancers, 21 of which were depicted as spiculated masses and/or distortions.
  (Skaane P. Eur Radiol 2013)
Conclusion (2): 3D versus supplemental views for evaluation of noncalcified breast lesions

- 33% of cancers are rated ACR5 with 2D vs 39% with 3D (p=0.017) (Zuley M. Radiology 2013)
- 3D can replace additional mammographic views in clinical practice (Lourenco A. Radiology 2015)
• 48 year-old-woman
• Screening mammography
3D C-view: two masses IDC
• Mammography 2D
  → Asymmetry
  → Recall for spot compression
  → Ultrasound and biopsy

• Tomosynthesis
  → Masses
  → No recall for supplementary views
  → Ultrasound and biopsy
**Conclusion:** 3D and recall

<table>
<thead>
<tr>
<th>Abnormality Type</th>
<th>DM (n = 1175)</th>
<th>2D</th>
<th>DBT (n = 827)</th>
<th>3D</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asymmetry</td>
<td>379 (32.3) [29.6, 35.0]</td>
<td>110 (13.3) [11.1, 15.9]</td>
<td>&lt;.0001* [15.3, 22.6]</td>
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<tr>
<td>Focal asymmetry</td>
<td>378 (32.2) [29.5, 34.9]</td>
<td>151 (18.3) [15.7, 21.1]</td>
<td>&lt;.0001* [10.1, 17.8]</td>
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<tr>
<td>Calcification</td>
<td>158 (13.4) [11.6, 15.6]</td>
<td>168 (20.3) [17.7, 23.3]</td>
<td>&lt;.0001* [-10.3, -3.4]</td>
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<tr>
<td>Distortion</td>
<td>7 (0.6) [0.2, 1.3]</td>
<td>44 (5.3) [3.9, 7.1]</td>
<td>&lt;.0001* [-6.4, -3.0]</td>
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<tr>
<td>Mass</td>
<td>105 (8.9) [7.4, 10.7]</td>
<td>222 (26.8) [23.9, 30.0]</td>
<td>&lt;.0001* [-21.4, -14.4]</td>
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<tr>
<td>Multiple</td>
<td>146 (12.4) [10.6, 14.5]</td>
<td>132 (16.0) [13.6, 18.7]</td>
<td>.0287 [-6.8, -0.3]</td>
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<tr>
<td>Other</td>
<td>2 (0.2)</td>
<td>0</td>
<td>Not applicable</td>
<td></td>
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</tbody>
</table>

Note.—Data are numbers of abnormalities. Numbers in parentheses are percentages. Numbers in brackets are 95% CIs (in percentages).

* Significant, where \( \alpha = 0.001 \).
- 86-year-old women
- Radiofrequency ablation of left IDC in 2008
- Follow-up by mammography/US/MRI

Pre-treatment (2008)

Follow-up (2009→2013)

• 200772748
Stable post-operative sequellae
Spot compression

Digital full-field mammography 2D
Biopsy 14G : invasive ductal carcinoma
Conclusion: second-look 3D

- 3D improves the characterization of additional MR findings not identified at targeted breast (standard) US

- After preoperative breast MRI, 3D identified a further 32 of the 50 lesions unidentified on targeted US

(Mariscotti G. Eur Radiol 2015)
64 year-old woman
No personal history
No family history
Doubt about left architectural distortion on mammography/negative ultrasound
Ultrasound: No abnormality

Cranio-caudal 2D

Lateral view
Cranio-caudal 3D

2D

Cranio-caudal 3D
Targeted ultrasound:
- Subtle architectural distorsion: ACR4
- Vacuum-assisted biopsy indicated
Biopsy 10 G under tomosynthesis guidance
Biopsy 10 G under tomosynthesis guidance
Deployment of a clip marker

Radial scar
• Concordant but known underestimation (4%)
• Open surgery
• Final histological results:
  complex sclerosing lesion papilloma
  atypical epithelial atypia
• 3D enables better visualization of architectural distortion (AD) and its associated spiculations  
  (*Partyka L AJR 2014*)

• 3D more informative than 2D in 94.4% of AD  
  (*Yang Biomed Res Int 2013*)

• Increase sensitiviy of 3D in cancers manifesting as spiculated masses and AD  
  (*Skaane Acta Radiol 2012*)
Conclusion (2)

- Follow-up or biopsy under 3D of subtle distortion detected only with 3D?

- Tomosynthesis improved ($p < 0.05$) the identification of radial scar (overdiagnosis)

  *Dominguez et al. Radiol Med 2014*

- New management? Percutaneous ultrasound-guided vacuum-assisted removal versus surgery for small lesions < 1 cm?
• Screening mammography
• Normal previous examination
Intermediate grade ductal carcinoma in situ
Conclusions (1): synthesized mammogram

- Synthetically reconstructed 2D mammogram from the multiple projection views
- Acceptable for routine in USA (1 firm)
- Reduces the radiation exposure
- Enhances small details (microcalcifications)
- Still a work-in-progress
Conclusions (2): 3 D and microcalcifications

- Clinical experience: some potential pitfalls

- Calcifications may be different (less visible on 3D) and classified differently (underestimated) (*Tagliafico Eur radiol 2015*)

- 3D images reviewed as individual slices, or slabs and optimal slabbing may be cluster dependant
Fig. 3—Diagrams show how calcifications can be difficult to perceive on planes through volume but are more easily appreciated on slab images. Adapted with permission from [50].

A. Cluster of calcifications is perceived because 2D mammogram distribution catches reader’s attention.
B. Clustering can be difficult to perceive as a reader pages through volumes because brain does not appreciate cluster.
C. Cluster becomes evident when planes are put together to make slab and slab is moved through volume by use of maximum intensity projection within slab.
Conclusions (2): 3D and microcalcifications

- No change in detection of DCIS with 3D (microcalcifications easily seen in 2D) (Gilbert 2013)

- Studies on synthesized image and microcalcifications are necessary

- 3D doesn’t replace 2D magnification for microcalcifications
Take-home messages: 3D

- Increases sensitivity and decreases false-positive recall rates
- Has approval for diagnostics
- Hasn’t approval for screening in France
- However there are issues with 3D as a screening tool including additional reading time, storage, … (Gilbert F. Clinical Radiology 2016)