The Impact of Tomosynthesis on Breast Cancer Screening

Professor dr. med. Per Skaane

Oslo University Hospital Ullevaal
Breast Imaging Center
Oslo / Norway

PERSKA@ous-hf.no
Objectives: The Impact of Tomosynthesis on Breast Cancer Screening

- Tomosynthesis (DBT) in breast imaging
- Potential role of synthetic 2D images in DBT screening
- Results from DBT screening so far
- Conclusions

Disclosure:
Oslo Tomosynthesis Screening Trial
Equipment and support for additional reading provided by Hologic, Inc.
Potential role of Digital Breast Tomosynthesis (DBT)

• **Microcalcifications:** DBT equal/comparable to FFDM
  - Spangler ML: AJR 2011;196:320
  - Kopans D: Breast J 2011;17:638

• **Tumor (cancer) size assessment:** DBT superior to FFDM
  - Fornvik B: Acta Radiol 2010;51:240
  - Mun HS: Clin Radiol 2013;68:1254

• **Specificity:** Increased when used adjunctively with FFDM
  - Poplack SP: AJR 2007;189:616
  - Gur D: AJR 2009;193:586

• **Replacement of supplemental diagnostic views:** For non-calcified lesions
  - Zuley ML: Radiology 2013;266:89

• **Cancer visibility and conspicuity:** DBT superior to FFDM
  - Andersson I: Eur Radiol 2008;18:2817
  - Michell MJ: Clin Radiol 2012;67:976

i.e., DBT might have a great potential in mammography screening!!
Quality assurance in mammography screening:

<table>
<thead>
<tr>
<th>Performance indicator “Recall rate”</th>
<th>Acceptable level</th>
<th>Desirable level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial screening examinations</td>
<td>&lt; 7 %</td>
<td>&lt; 5 %</td>
</tr>
<tr>
<td>Subsequent screening examinations</td>
<td>&lt; 5 %</td>
<td>&lt; 3 %</td>
</tr>
</tbody>
</table>
A) Potential role of Tomosynthesis in breast cancer screening: 

Increased cancer conspicuity
B) Potential role of Tomosynthesis in breast cancer screening:
Visibility of FFDM-occult cancer
C) Potential role of Tomosynthesis in breast cancer screening: Increased conspicuity occasionally even in fatty breasts
Tomosynthesis (DBT) in breast cancer screening

Why do we need 2D (FFDM) in addition to tomosynthesis:
- Needs 2D for comparison of priors vs. current exams
- Needs 2D for comparison right vs left breast
- Current 2D exam might be requested by other institutions
- Studies have shown that the combination of 2D + DBT has higher sensitivity (cancer detection) and specificity (lower recall)

Two view 2D (CC+MLO) plus two view DBT (CC+MLO) means approximately a «doubling» of the radiation dose!

However:
Synthetic 2D views may substitute for FFDM images when combined with tomosynthesis, reducing substantially the radiation dose!
**Synthetic 2D generation:**

Tomosynthesis reconstructed slices

![Diagram](image)

Synthesized Projection

Synthetic 2D image (called C-View by Hologic) shows a roadmap of the important features from tomosynthesis slices
Synthetic 2D image

Left CC: FFDM (2D)  26.11.2010

Left CC: C-View  26.11.2010

Left CC: Tomo  26.11.2010
Oslo Tomosynthesis Screening Trial (OTST): First year results *

Women 2D + (2D+3D): n = 12,631
Malignancy: n = 130
Malignancy rate: 1.03%

Excl. 10 women with malignancy:
- 2 palp. cancer (clin recall)
- 3 Interval cancers (IC)
- 5 Lymphomas/metastases

Arm A (2D): n = 12,621
Cancers: n = 77
Cancer detection rate: 0.61%

Arm C (2D + 3D): n = 12,621
Cancers: n = 101
Cancer detection rate: 0.80%

Relative increase in cancer detection (2D+TOMO) vs. (2D): 31%

* Skaane P et al.: Radiology 2013; 267: 47-56
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Detected with 2D only</th>
<th>Detected with combo only</th>
<th>Detected with 2D and combo</th>
<th>Total with 2D</th>
<th>Total with combo</th>
<th>Difference combo vs 2D</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. cancer</td>
<td>6</td>
<td>30</td>
<td>71</td>
<td>77</td>
<td>101</td>
<td>24</td>
</tr>
<tr>
<td>Inv. Cancer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDC</td>
<td>4</td>
<td>29</td>
<td>52</td>
<td>56</td>
<td>81</td>
<td>25</td>
</tr>
<tr>
<td>IDC+DCIS</td>
<td>2</td>
<td>16</td>
<td>33</td>
<td>35</td>
<td>49</td>
<td>14</td>
</tr>
<tr>
<td>ILC</td>
<td>0</td>
<td>5</td>
<td>11</td>
<td>11</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td>Others</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td>8</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>Radiol. finding</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Circ.mass</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>7</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td>Spicul.mass</td>
<td>3</td>
<td>12</td>
<td>25</td>
<td>28</td>
<td>37</td>
<td>9</td>
</tr>
<tr>
<td>Distortion</td>
<td>0</td>
<td>8</td>
<td>8</td>
<td>8</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Asymm.dens</td>
<td>1</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Mc</td>
<td>0</td>
<td>0</td>
<td>8</td>
<td>6</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Density+mc</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>DCIS</td>
<td>2</td>
<td>1</td>
<td>19</td>
<td>21</td>
<td>20</td>
<td>-1</td>
</tr>
<tr>
<td>Low grade</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>High grade</td>
<td>2</td>
<td>1</td>
<td>15</td>
<td>17</td>
<td>16</td>
<td>-1</td>
</tr>
</tbody>
</table>

* Skaane P et al.: Radiology 2013; 267: 47-56
Tomosynthesis in breast cancer screening:
Studies comparing FFDM and Digital Breast Tomosynthesis DBT (January 2014)

<table>
<thead>
<tr>
<th>Study</th>
<th>Population (n)</th>
<th>Study design</th>
<th>Examination mode</th>
<th>Reading mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trento/Verona (STORM)</td>
<td>7,292</td>
<td>Prospective; paired</td>
<td>2D: 2-view</td>
<td>Double; Sequential</td>
</tr>
<tr>
<td>Oslo (OTST)</td>
<td>12,631</td>
<td>Prospective; paired</td>
<td>2D: 2-view; 3D: 2-view</td>
<td>Double; Independent</td>
</tr>
<tr>
<td>TOPS Compr. Breast Center, Houston, TX</td>
<td>2D: 13,856; 3D: 9,499</td>
<td>Retrospective; non-paired</td>
<td>2D: 2-view; 3D: 2-view</td>
<td>Single; Independent</td>
</tr>
<tr>
<td>Yale University (New Haven, CT)</td>
<td>2D: 7,058; 3D: 6,100</td>
<td>Retrospective; non-paired</td>
<td>2D: 2-view; 3D: 2-view</td>
<td>Single; Independent</td>
</tr>
<tr>
<td>Malmö (MBTST)</td>
<td>5,700</td>
<td>Prospective; paired</td>
<td>2D: 2-view; 3D: 1-view</td>
<td>Double; Sequential</td>
</tr>
</tbody>
</table>

1) Ciatto S et al.: Lancet Oncol, 2013 (Screening with Tomo OR standard Mammo (STORM))
2) Skaane P et al.: Eur Radiol, 2013 (Oslo Tomosynthesis Screening Trial OTST)
3) Rose SL et al.: AJR, 2013 (Implementation of breast tomo in a routine screening practice)
4) Haas BM et al.: Radiology, 2013 (Comparison of tomo plus 2D and 2D alone for screening)
5) Zackrisson S: ECR Vienna, 2013 (Interim analysis; Malmö Breast Tomosynthesis Screening Trial)
# Tomosynthesis in breast cancer screening:

Studies comparing FFDM and Digital Breast Tomosynthesis DBT (January 2014)

<table>
<thead>
<tr>
<th>Study</th>
<th>Population (n)</th>
<th>Cancer (n)</th>
<th>Cancer (n / 1,000)</th>
<th>Cancer: Rel. increase (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trento/Verona (STORM) 1</td>
<td>7,292</td>
<td>39/59</td>
<td>5.3/8.1</td>
<td>51%</td>
</tr>
<tr>
<td>Oslo (OTST) 2</td>
<td>12,631</td>
<td>90/119</td>
<td>7.1/9.4</td>
<td>32%</td>
</tr>
<tr>
<td>TOPS Compr. Breast Center, Houston, TX 3</td>
<td>2D: 13,856</td>
<td>56/51</td>
<td>4.0/5.4</td>
<td>32%</td>
</tr>
<tr>
<td></td>
<td>3D: 9,499</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yale University 4 (New Haven, CT) 4</td>
<td>2D: 7,058</td>
<td>37/35</td>
<td>5.2/5.7</td>
<td>9.5%</td>
</tr>
<tr>
<td></td>
<td>3D: 6,100</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malmø (MBTST) 5</td>
<td>5,700</td>
<td>-/-</td>
<td>4.7/6.8</td>
<td>45%</td>
</tr>
</tbody>
</table>

1) Ciatto S et al.: Lancet Oncol, 2013 (Screening with Tomo OR standard Mammo (STORM))
2) Skaane P et al.: Eur Radiol, 2013 (Oslo Tomosynthesis Screening Trial OTST)
3) Rose SL et al.: AJR, 2013 (Implementation of breast tomo in a routine screening practice)
4) Haas BM et al.: Radiology, 2013 (Comparison of tomo plus 2D and 2D alone for screening)
5) Zackrisson S: ECR Vienna, 2013 (Interim analysis; Malmø Breast Tomosynthesis Screening Trial)
Median reading time (sec.) for 2D (arm A) and 2D+3D (arm C)

Period 1: 22.11.2010 – 01.07.2011
Period 2: 01.08.2011 – 21.12.2011
Period 3: 01.01.2012 – 01.07.2012


“Withholding medical information from patients without their knowledge or consent is ethically unacceptable”.


The addition of breast MRI or ultrasound to mammography increases the detection of small node-negative cancers beyond that achieved with mammography alone.

Berg, 2008
Potential techniques as adjunct to mammography for personalized screening in women with dense breasts:

1) Ultrasonography: **ABUS performed by radiographers**
   - Availability: Favour
   - Costs: Disfavour
   - Option: Low-volume screening

2) Breast MRI: **Highest sensitivity**
   - Availability: Disfavour
   - Costs: Disfavour
   - Option: High-risk screening

3) Tomosynthesis: **Not another modality - just «a better mammogram»!**
   - Availability: Favour
   - Costs: Favour
   - Option: High-volume screening
Thank you very much for your time and attention!

The Mammography Screening Team in Oslo

PERSKA@ous-hf.no