Application of 3D printed Breast Surgical Guide for Breast Conserving Surgery in DCIS Patients

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DCIS trends

Number of Patients

Percentage

<table>
<thead>
<tr>
<th>Year</th>
<th>Stage 0</th>
<th>Stage I</th>
<th>Stage II</th>
<th>Stage III</th>
<th>Stage IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
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<td>10.7</td>
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<td>31.1</td>
<td>34.4</td>
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<td>34.7</td>
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<tr>
<td>2004</td>
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<td>48.9</td>
<td>38.9</td>
<td>35.8</td>
<td>43.2</td>
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<td>2006</td>
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<td>11.2</td>
<td>15.8</td>
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<td>2008</td>
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<td>9.2</td>
<td>13.2</td>
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<tr>
<td>2010</td>
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<td>33.9</td>
<td>43.2</td>
<td>43.2</td>
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<td>2012</td>
<td>34.4</td>
<td>36.5</td>
<td>41.7</td>
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<tr>
<td>2014</td>
<td>43.2</td>
<td>38.9</td>
<td></td>
<td></td>
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<tr>
<td>2016</td>
<td>41.7</td>
<td>31.5</td>
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</tbody>
</table>
DCIS extent

In many cases, DCIS is a non-palpable mass and accurate image measurement is important.

The accuracy of determining the DCIS extent varies with different modalities:

- MMG  87%-95%
- US  47%-71.3%
- MRI  73%-100%
Methods to determine DCIS extent for surgical resection

<table>
<thead>
<tr>
<th>Technique</th>
<th>Rate of adequate margins</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon marking</td>
<td>81.1%</td>
<td>Possible foreign-body reactions mimicking malignancy on follow up; obstruction of needle tip due to charcoal precipitation.</td>
</tr>
<tr>
<td>Wire-guided</td>
<td>70.8–87.4%</td>
<td>Wire dislodgment; vasovagal episodes; pneumothorax.</td>
</tr>
<tr>
<td>ROLL</td>
<td>75–93.5%</td>
<td>Possible widespread dispersal of the tracer by accidental intraductal injection; nuclear medicine department required; for experienced surgeons; expensive.</td>
</tr>
<tr>
<td>Clip marker</td>
<td>90–92%</td>
<td>Clip migration.</td>
</tr>
<tr>
<td>US-guided</td>
<td>89–97%</td>
<td>DCIS rarely visible on US if not marked with a clip or hematoma.</td>
</tr>
<tr>
<td>Cavity shave</td>
<td>91.3–94.4%</td>
<td>Long operative times.</td>
</tr>
<tr>
<td>Imprint cytology and frozen section analysis</td>
<td>89–91%</td>
<td>Sensibility equal to 72–83%; possible difficult interpretation by pathologist due to presence of irregular specimen's surfaces or atypical cells; long operative times.</td>
</tr>
</tbody>
</table>
Wire localization

- Displacement
- Difficult placement in dense breast
- Pain, Vasovagal syncope
- Pneumothorax
- Transection, loss of wire
- Interference with the surgical approach

Archives of Surgery. 1988
European journal of surgical oncology. 1998
AJR. American journal of roentgenology. 1991
Radio guided occult lesion localization (ROLL) / Radioactive seed localization (RSL)

• Clear margin rate ↑, Re-excision rate↓, good cosmetic result↑ convenience ↑

J Surg Oncol. 2008
The breast journal. 2008
Annals of Surgical Oncology. 2001
ROLL, RSL / WL

- No significant differences in surgical margin, re-excision rate, reoperation rate, ratio of the tumor volume to initial surgical specimen volume, ratio of the tumor volume to total volume resected, or clinical in computed cosmesis scores.  
  *American Journal of Roentgenology. 2015*

- No differences in positive margins rates, positive or close margins rates, specimen volume, weight, reoperation, and localization times
  
  *Annals of surgical oncology. 2011*
Limitation: WL, ROLL, RSL

- MRI guide localization is difficult
- Difficulty with quantitative marking
- Migration
- Radiation exposure
- Loss
- Pain

How do we target tumor?
3D guide !! idea

• Previously produced, operative time consumption > NO

• Injection after GA, Pain> NO

• No risk of Migration or dislodgment, NO radiation

• Quantitatively mark the area of resection using MRI information.

• Margin status!!!
How

MRI

3D modeling
Version development
Study-results

- 6 patients with DCIS
- Median age: 48 years
- Median Operative time: 53 min
- All patients had tumor free resection margins
- The median distance from the tumor to the margin was 10 mm (range, 1 to 20).

<table>
<thead>
<tr>
<th>patient</th>
<th>US</th>
<th>MRI</th>
<th>Path</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient 1</td>
<td>0.6</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Patient 2</td>
<td>0.4</td>
<td>0.5</td>
<td>0.6</td>
</tr>
<tr>
<td>Patient 3</td>
<td>0.8</td>
<td>0.7</td>
<td>0.5</td>
</tr>
<tr>
<td>Patient 4</td>
<td>0.9</td>
<td>0.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Patient 5</td>
<td>2.6</td>
<td>2.2</td>
<td>2.5</td>
</tr>
<tr>
<td>Patient 6</td>
<td>1.0</td>
<td>4.8</td>
<td>0.8</td>
</tr>
</tbody>
</table>
Summary

• 3DP-BSG is applied in six DCIS patients.

• All patients have adequate margin and tumors are completely removed.

• Limitation

  ✓ Fewer patients

  ✓ No investigation of removed volumes or cosmetic results
Thank You