Recommendations from GEC ESTRO Breast Cancer Working Group (I):
Target definition and target delineation for accelerated or boost Partial Breast Irradiation using multicatheter interstitial brachytherapy after breast conserving closed cavity surgery.

Vratislav Strnad¹, Erik Van Limbergen², Jean-Michel Hannoun-Levi³, Jose-Luis Guinot⁴, Kristine Lössl⁵, Daniela Kauer-Dorner⁶, Alexandra Resch⁷, György Kovács⁷, Tibor Major⁸, Csaba Polgár⁸ on behalf of Working Group Breast Cancer of GEC-ESTRO
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What we can use?

1. Scar - skin
2. Imaging (Ultrasound, Mammography, MRI, CT)
3. Surgical report
4. Surgical clips
5. Scar inside of breast
Scar on the skin

Limited value!!

Target localization - BACKGROUND
Mammography before surgery

...but:

• Squeezing of tissue must be respected
• Distances – only limited value
Target localization - BACKGROUND
Ultrasound and mammography after surgery

- no value after CLOSED CAVITY surgery
- useful after OPEN CAVITY surgery

Target localization - BACKGROUND
CT after surgery

CLOSED CAVITY

CVS 1
No cavity

CVS2
Heterogenous cavity with indistinct margins

CVS3
Heterogenous cavity with some indistinct margins

OPEN CAVITY

CVS4
Mildly heterogenous cavity with mostly distinct margins

CVS5
Homogenous cavity with clearly identified margins

Cavity Visualization Score

DM Landis et al., IJROBP, 2007, 67, 1299-1308
CT after surgery

Target localization - BACKGROUND
Surgical report:
- Closed cavity
- Open cavity
- Plastic reconstructions
- Clips – yes/no

Quadrantectomy

Plastic reconstruction

Wide excision

Target localization - BACKGROUND
GEC-ESTRO guidelines for target definition in breast brachytherapy

GUIDELINES

BACKGROUND

Target localization

Target definition

AVAILABLE INFORMATIONS

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Basic informations

Surgical report:

1. Closed cavity
2. Open cavity
3. Plastic reconstructions
4. Clips – yes/no

Pathology:

1. Tumor size
2. Resection margins in all 6 directions!
TWO KEY QUESTIONS

1. How large should be the **size of the safety margin** (existing resection margin + „brachytherapy“ safety margin)??

2. What we know about **the accuracy of estimation of position of the resection margins** in corresponding directions.

Consequently, how should we respect the possible inaccuracy by our definition of size of safety margins?
Target definition

Margin size? (resection margin + „brachytherapy“ safety margin)??

- Faverly / Holland, Europe
- Ohtake, Japan
- Imamura, Japan
- Vicini /Goldstein USA
## Target definition

### Margin size? (resection margin + „brachytherapy“ safety margin)

### Answers:

<table>
<thead>
<tr>
<th></th>
<th>pts. (n)</th>
<th>needed safety margins</th>
</tr>
</thead>
<tbody>
<tr>
<td>Faverly:</td>
<td>135</td>
<td>20 mm</td>
</tr>
<tr>
<td>Ohtake:</td>
<td>20</td>
<td>8 mm</td>
</tr>
<tr>
<td>Imamura:</td>
<td>324</td>
<td>30 mm</td>
</tr>
<tr>
<td>Vicini/Goldstein:</td>
<td>333</td>
<td>10 mm</td>
</tr>
</tbody>
</table>
The size of "safety margin's" (existing resection margin + "brachytherapy" safety margin) should be by 2 cm in all directions.

Summary:

The size of "safety margin's" (existing resection margin + "brachytherapy" safety margin) should be by **2 cm** in all directions.
TWO KEY QUESTIONS

1. How large should be the **size of the safety margin** (existing resection margin + „brachytherapy“ safety margin)??

2. What we know about **the accuracy of estimation of position of the resection margins** in corresponding directions.

   Consequently, how should we respect the possible inaccuracy by our definition of size of safety margins?
Accuracy of estimation of position of the resection margins

...accuracy of clips?

Accuracy of clips:

1. During the time \( \pm 3\text{mm} \).

2. Random inaccuracy: No data, only estimation possible - at least \( \pm 3-5\text{mm} \).

Target definition - BACKGROUND
Consequences for target delineation …
Guidelines for target delineation after breast conserving closed cavity surgery

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1. The target delineation is to make **CT based** – without contrast agent.

2. Please visualize the **skin scar** and delineate **surgical clips**.

3. Delineate **Whole Surgical Scar – WS** (between skin scar and surgical clips).

4. Delineate **Imaging related target volume – ImTV**.

5. Delineate **Estimated tumour bed - ETB**.

6. Delineate **Clinical target volume - CTV**.

7. Delineate, only if necessary and useful, **Planning target volume – PTV**.
1. Perform a CT with a mark on the middle of the skin scar

**Delineation of clips**

Two kinds of clips: intraparenchymal and on thoracic wall

- The clinician decides which clips are relevant for delineating the surgical bed and which clips are considered as part of the target clinically “**target relevant surgical clips**”.
- We need a **precise surgical report** in which the surgeon describes the number and the position of the clips and what are the “relevant” and “non relevant”.
Guidelines for target delineation after breast conserving closed cavity surgery

2. Delineation of the surgical bed (Whole Scar, WS) inside the breast

✓ Delineate the surgical bed that is the visible scar of the closed cavity, including the whole scar and all the clips.

✓ Whenever the scar is not visible, the space between the skin scar and clips on the thoracic wall can be delineated as virtual scar (depending of the breast size).

✓ If there are no clips and the scar is not visible, tumor bed cannot be delineated.
Guidelines for target delineation after breast conserving closed cavity surgery
Definition and delineation of **ImTV (Imaging correlated Target Volume)** by using preoperative mammography, ultrasound, MRI.

1. Take the **relative distance between the center of the visible tumor** on the mammograms to the skin and chest wall.

2. In this relative distance and position delineate the projection of the largest tumor size on the scan.

\[
\frac{18}{42} = 0.42 \\
\frac{25}{60} = 0.42
\]
Guidelines for target delineation after breast conserving closed cavity surgery

**Imaging correlated Target Volume**

1. Take the relative distance between the center of the visible tumor on the mammograms to the skin and chest wall.
2. In this relative distance and position delineate the projection of the largest tumor size on the scan.

GEC-ESTRO Breast Working Group, 2011-2014
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Imaging correlated Target Volume (ImTV)
Definition and delineation of **ETB (Estimated Tumour Bed)**

In consideration of three factors:

1. **clinically “target relevant surgical clips”**,  
2. **whole scar (WS) and**  
3. **ImTV**

The physician delineate ETB as **part of the whole surgical scar** that is considered as related to the tumor position and tumor size.
Guidelines for target delineation after breast conserving closed cavity surgery
Definition and delineation of CTV (Clinical Target Volume)

CTV = ETB plus adapted safety margins: 20 mm minus surgical margin, but at least 10 mm (a surgical margin of 3 mm requires a safety margin of 17mm).

Thoracic wall and skin (thickness 5 mm) are not the part of CTV.
CTV

Guidelines for target delineation after breast conserving closed cavity surgery
Delineation of **PTV (Planning target volume)** - clinical decision, if reasonable

\[ PTV = CTV + 5 \ (10) \ \text{mm} \]

- To respect the random inaccuracy of positioning of surgical clips.
- Whenever there is uncertainty in the definition of the scar (CVS1, Landis)
- For External Beam Radiation Therapy another safety margin will be required, as usual.
Guidelines for target delineation after breast conserving closed cavity surgery

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PTV(Brachy) vs. PTV(EBRT) vs. PTV(EVAL)
1. **CTV** is defined as the **sum of the relevant clipped area (RCA) and the distance of 20 mm** minus the smallest surgical free margin (SFM) defined by the pathologist (CTV = RCA + (20 - SFM)).

2. **PTV** is defined as the **CTV + 10 mm**.

   The additional distance of 10 mm resulting from the interobserver delineation variability is not influenced by setting clip markers.
Guidelines for target delineation after breast conserving closed cavity surgery

SUMMARY

1. The target delineation is to made CT based – without contrast agent.
2. Please visualize the skin scar and delineate surgical clips.
3. Delineate Whole Surgical Scar (WS).
4. Delineate Imaging related target volume (ImTV).
5. Delineate Estimated tumour bed (ETB).
6. Delineate Clinical target volume (CTV).
7. Delineate, if necessary and usefull, Planning target volume (PTV).
8. Please be carefull by very large target volumes ~ >200 cc!
9. Please be very careful and reserved by patient with very high density of breast parenchyma – here large interobserver variability (bad conformity and large Hausdorff distances) has been detected. Probably a MRI-planning should be done.

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Target delineation
Recommendations for daily routine

Recommendations from GEC ESTRO Breast Cancer Working Group:
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Follow guidelines and use common sense!