

# Diagnosis and Treatment of Patients with early and advanced Breast Cancer



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## Breast Cancer Surgery Oncological Aspects

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# Breast Cancer Surgery

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### ■ Version 2025

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**AGO: ++**

**Surgery is one sub-step out of multiple steps in breast cancer treatment. Thus, both diagnostic and oncological expertise are an essential requirement for every breast surgeon.**

**AGO: +**

**Avoidance of a significant delay in cancer treatment**

**AGO: ++**

**Surgical therapy decisions should be made in the context of a multimodal therapy concept as part of a preoperative, interdisciplinary tumor conference.**

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# Pre-Therapeutic Assessment of the Breast

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- **Clinical examination**
- **Sonography (breast)**
- **Mammography (completion of the imaging)**
- **MRI\***
- **Contrast-enhanced mammography (alone) if available;  
consider radiation sensitivity of the breast (age)\***
- **Tomosynthesis (DBT) + SM\*\***
- **Breast-CT**
- **Minimally invasive biopsy of further lesions (CNB, VAB)**
- **Tagging the tumor, if neoadjuvant therapy planned**

	Oxford		
	LoE	GR	AGO
	5	D	++
	2b	B	++
	2b	B	++
	1b	A	+
	2a	B	+
	2b	B	+
	4	D	-
	1b	A	++
	1c	A	++

\* MRI- or CEM guided vacuum biopsy is mandatory in case of MRI- or CEM detected additional lesions (in-house or with cooperations).

Individual decision for patients at high familiar risk, with dense breast (density C / D), lobular invasive tumors, suspicion of multilocular disease.

\*\* Replacement of additional FFDM by SM in order to reduce the exposure to radiation.

# Pre-therapeutic Assessment: Axilla

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- **Clinical examination**
- **Sonography**
- **CNB Axilla, if suspicious LN and marking of the node if TAD planned  $\leq 3$  susp. LN\***
- **MRI**
- **Mammography (FFDM)**
- **Tomosynthesis (DBT)**
- **Contrast-enhanced mammography (CEM, alone)**
- **PET CT / MRI for axillary LN**
- **Breast-CT**

	Oxford		
	LoE	GR	AGO
	5	D	++
	2a	B	++
	2b	B	++
	1b	A	+
	2b	B	-
	2b	B	-
	2a	B	-
	2b	B	-
	4	D	-

# Pre-therapeutic Staging

	Oxford		
	LoE	GR	AGO
	5	D	++
<b>History and clinical examination</b>			
<b><u>Only in case of high metastatic potential and/or symptoms and/or indication for (neo-) adjuvant chemotherapy and/or antibody-therapy:</u></b>			
▪ CT scan of thorax / abdomen / pelvis	2a	B	++
▪ Bone scan	2a	B	+
▪ Chest X-ray	5	C	+/-
▪ Liver ultrasound	5	D	+/-
▪ Further investigation in case of additional suspicious lesions (e.g. liver-MRI, CEUS*, biopsy etc.)	2a	B	+
▪ FDG-PET or FDG-PET-CT** FDG-PET-MRI**	2a	B	+/-
▪ Whole body MRI	2a	C	+/-

\* Contrast enhanced ultrasound

\*\* Particularly in patients with high tumor stage (III) if available.

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# Evidence of Surgical Procedure

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	Oxford	
	LoE	GR
<ul style="list-style-type: none"> <li>Survival rates after lumpectomy + RT are at least equivalent to those after (modified) radical mastectomy</li> </ul>	1a	A
<ul style="list-style-type: none"> <li>Local recurrence rates after skin sparing mastectomy are equivalent to those after mastectomy</li> </ul>	2b	B
<ul style="list-style-type: none"> <li>Conservation of the NAC (nipple areola complex) is an adequate surgical procedure, if R0 resection is achieved</li> </ul>	2b	C

# Breast-Conserving Surgery (BCS): Options to Localize Non-Palpable Lesions

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- **Wire-guided localization**
- **Wireless intraoperative ultrasound-guided localization\***
- **Other procedures:\*\***

**Radar reflectors**

**Magnetic marker\*\*\***

**Paramagnetic markers\*\*\***

**MagSeed™ (compared with wire localization)\*\*\***

**Radiofrequency-based markers (RFID)\*\*\***

**Radionuclide-guided localization (ROLL)**

**Radioactive seeds\*\*\*\***

Oxford		
LoE	GR	AGO
1a	A	++
1a	A	++
2b	B	+/-
2b	B	+/-
1b	A	+
2b	B	+/-
1a	A	+/-
1a	A	+/-

\* The lesion must be sonographically visualized by the same examiner pre- and intraoperatively in its whole extension. Adequate equipment and training of the surgeon are mandatory.

\*\* according to approval

\*\*\* not suitable for MRI-based response assessment under NACT

\*\*\*\* not approved in Germany

# Localization Methods for non-Palpable Breast Cancer: a Meta-Analysis



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## **Athanasίου et al. Eur J Surg Onc 2021:**

- Meta-analysis of RCTs
- 18 studies with 3112 patients
- Pairwise and network meta-analysis

### Ultrasound-guided surgery vs. wire-guided surgery:

- decreased positive margin both in the pairwise [OR = 0.19 (0.11, 0.35);  $p < 0.01$ ] and network meta-analysis [OR = 0.19 (0.11, 0.60)]
- a statistically significant reduction in re-operation rate [OR = 0.19 (0.11, 0.36);  $p < 0.01$ ] and operative time [MD = -4.24 (-7.85, -0.63);  $p = 0.02$ ]

### Ultrasound-guided surgery vs. ROLL / RSL:

- a statistically significant reduction in positive margin compared to ROLL [OR = 0.19 (0.11,0.6)] and RSL [OR = 0.26 (0.13, 0.52)]

**„Ultrasound-guided surgery has potential benefits in reduction of positive surgical margin, the rest of the techniques seem to have equivalent efficacy.“**

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# Breast-Conserving Surgery (BCS): Resection Margins

	Oxford		
	LoE	GR	AGO
<ul style="list-style-type: none"> <li> <b>Invasive breast cancer without extensive intraductal component (EIC)*</b> <ul style="list-style-type: none"> <li>Aim: tumor-free margins (“no ink on tumor“ is sufficient even in case of unfavorable tumor biology)</li> <li>Re-excision for invasive or non-invasive tumor cells reaching margin (final histology)</li> </ul> </li> </ul>	2a	A	++
<ul style="list-style-type: none"> <li> <b>Invasive breast cancer with EIC*</b> <ul style="list-style-type: none"> <li>Re-excision for invasive or non-invasive tumor cells reaching margin (final histology)</li> <li>Re-excision in case of a close margin of the intraductal component (&lt; 2 mm on final histology)**</li> </ul> </li> </ul>	2a	B	++
	2a	B	-

\* No clear definition of EIC in the literature. Increased risk of local recurrence in case of EIC with at least twice the greatest dimension of the invasive tumor component (definition according to the German S3 guideline).

\*\* Individual approach with consideration of patient’s age and tumor extent.

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# Breast-Conserving Surgery (BCS): Surgical and Technical Aspects

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- **Specimen radiography and / or -sonography in non-palpable lesions and / or tumor-associated microcalcifications\***
- **Intraoperative ultrasound to increase negative margin rates in non-palpable lesions**
- **Intraoperative ultrasound to increase negative margins rates in palpable lesions (with smaller resection volumes)**
- **Surgical clip marking of the tumor bed if boost or partial breast irradiation is indicated**
- **Intraoperative margin evaluation (with Margin Probe®)**
- **Therapeutic stereotactic excision alone**

	Oxford		
	LoE	GR	AGO
	<b>2b</b>	<b>B</b>	<b>++</b>
	<b>1a</b>	<b>A</b>	<b>+</b>
	<b>1b</b>	<b>B</b>	<b>+</b>
	<b>2b</b>	<b>B</b>	<b>+</b>
	<b>1b</b>	<b>A</b>	<b>+/-</b>
	<b>4</b>	<b>D</b>	<b>--</b>

\* Mandatory also for probe-guided detection systems (magnetic seeds, radar reflectors, RFID, radioactive seeds, ROLL).

# Breast-Conserving Surgery (BCS) without Neoadjuvant Therapy

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- **Multifocality / Multicentricity  
(R0 resection of all lesions required)**
- **Positive microscopic margins after repeated  
excision**
- **Inflammatory breast cancer**

Oxford		
LoE	GR	AGO
2b	B	+
2b	B	--
2b	B	--

# Axillary Lymph Node Dissection (ALND) without Neoadjuvant Chemotherapy

Oxford

## Recommendation for ALND:

- **Endpoint: Survival (if patient receives adequate multimodal therapy)**
- **Endpoint: Staging**
- **Endpoint: Locoregional control**
  - pN+ (histologically confirmed pre-surgery)
  - cN0 pN0 (i+) (sn)
  - cN0 pN1mi (sn)
  - cN0 pN1 (sn) (T1-3, < 3 SN+, BCS + RT + adequate systemic therapy)
  - cN0 pN1 (sn) and mastectomy (T1-2, < 3 SN+, no chestwall radiotherapy)
  - cN0 pN1 (sn) and mastectomy (T1-3, < 3 SN+, chestwall radiotherapy)

LoE	GR	AGO
3	D	-
3	A	-
2a	A	+/-
2a	B	+
1b	A	--
1b	A	--
1b	A	-
2b	B	+/-
1b	B	-

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# Axillary Surgery and NACT

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LoE

GR

AGO

cN status (before NACT)	pN status (before NACT)	ycN status (after NACT)	Axillary surgery (after NACT)	AGO	ypN status (after NACT and surgery)	Surgical consequence based on histopathology			
cN0	No surgery before NACT	ycN0	SLNE	++	ypN0 (sn)	none	2b	B	++
					ypN0 (i+) (sn)	ALND	2b	B	-
					ypN1mi (sn)	ALND	2b	C	+/-
					ypN1 (sn)	ALND	2b	C	++

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# Axillary Surgery and NACT (cN+)

Oxford

LoE

GR

AGO

cN status (before NACT)	pN status (before NACT)	ycN status (after NACT)	Axillary surgery (after NACT)	AGO	ypN status (after NACT and surgery)	Surgical consequence based on histopathology	LoE	GR	AGO	
cN+*	pN+ <sup>CNB</sup>	ycN0	ALND	+	ypN0 / ypN+	none	2b	B	++	
			TAD	+	ypN0	none	2b	B	+	
					ypN0 (i+)	ALND	2b	B	-	
					ypN1mi	ALND	2b	B	+/-	
			SLNE	+/-	ypN+	ALND				+
					ypN0	none	2b	B	+/-	
					ypN0 (i+)	ALND	2b	B	+/-	
			TLNE	+/-	ypN+ inkl. ypN1mi	ALND	2b	B	+	
					ypN0	none	2b	B	+/-	
		ypN0 (i+)			ALND	3b	B	+/-		
		ypN+ inkl. ypN1mi	ALND	3b	B	+				
		ycN+**	ALND	+	ypN0 / ypN+	none	2b	B	++	

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\* Study participation in AXSANA recommended, \*\* Cave: In 21.1% false-positive findings, consider CNB/TAD if necessary

# Targeted Axillary Dissection (TAD) = TLNE + SLNE

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	Oxford		
	LoE	GR	AGO
▪ Core needle biopsy and marking of suspicious lymph nodes (LN)	2b	B	++
▪ Marking of multiple LN if more than one LN is suspicious	2b	B	+/-
▪ Evidence for comparison of different markers (clip / coil, carbon, magnetic seed, radar reflector, radiofrequency-based marker etc.) is insufficient *	2b	B	
▪ TAD in case of 1-3 suspicious LN before NACT	2b	B	+
▪ TAD in case of ≥ 4 suspicious LN before NACT	5	D	+/-
▪ Full workup using step sections of ≤ 500 µm on paraffin embedded tissue	5	D	++
▪ Immunohistochemistry for ITC detection	2b	D	-
▪ ALND in case of pre- or intraoperatively undetectable marker	5	D	+
▪ Further intervention to retrieve lost marker (incl. after ALND)	5	D	-
▪ TLNE only without SLNE	2B	B	+/-

\* Study participation in AXSANA recommended.

# Sentinel Lymph Node Excision (SLNE)

## Indications I

Oxford		
LoE	GR	AGO
1b	A	++
1b	A	++
3b	B	+
3b	B	+
3b	B	-
1b	B	+
3b	B	+

- **Clinically / sonographically negative axilla (cN0)**
- **cT 1-2**
- **cT 3-4c**
- **DCIS**
  - **Mastectomy**
  - **BCT**
- **Omission of SLNE in postmenopausal patients (≥ 50 yrs., cT1 cN0, BCS + WBI, HR+/HER2-, G1/G2) according to SOUND / INSEMA**
- **Omission of axillary intervention in elderly patients (≥ 70 yrs., cT1 cN0, HR+/HER2-, mastectomy)**

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# Characteristics and Results of the SOUND and INSEMA Trial

Gentilini et al. JAMA Oncology, 2023

Reimer et al., N Engl J Med, 2024

	SOUND (median follow-up 5.7 years)	INSEMA (median follow-up 6.1 years)
<b>Randomization</b>	SLNB vs no SLNB (1:1)	SLNB vs no SLNB (4:1)
<b>n</b>	1,405 708 SLNB vs 697 no SLNB	4,858 3,896 SLNB vs 962 no SLNB
<b>Population</b>	cT ≤ 2 cm, cN0 (incl. ultrasound), invasive BC, BCT + radiotherapy	cT ≤ 5 cm (90% ≤ 2 cm), cN0 (incl. ultrasound), invasive BC, BCT + WBI
<b>Age</b>	Median (IQR) 60 years (52-68)	Median (IQR) 62 years (53-68)
<b>Intrinsic subtype, Grading, Ki-67 index</b>	HR-pos./HER2-neg. 87.8% G3: 17.9% Ki-67 index ≥ 20%: 36.1%	HR-pos./HER2-neg. 95.2% G3: 3.6% Ki-67 index > 20%: 12.9%
<b>Survival</b>	5y DDFS: 97.7% SLNB vs 98.0% no SLNB HR 0.84 (90% CI: 0.45-1.54)	5y iDFS: 91.7% SLNB vs 91.9% no SLNB HR 0.91 (95% CI: 0.73-1.14)
	5y OS 98.2% vs 98.4%	5y OS: 96.9% vs 98.2%
<b>Recurrence</b>	Local 1.0% SLNB vs 0.9% no SLNB Axillary 0.4% vs 0.7%	Local 1.1% SLNB vs 0.8% no SLNB Axillary 0.3% vs 1.0%



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# Sentinel Lymph Node Excision (SLNE)

## Indications II



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- **During pregnancy and / or breast feeding  
(only <sup>99m</sup>Tc-colloid, no patent or methylene blue dye, no data to SPIO or ICG)**
- **After prior tumor excision**
- **After prior major breast surgery  
(e.g. reduction mammoplasty)**
- **Ipsilateral breast recurrence after prior BCS  
and prior SLNE**
- **SLNE in the mammary internal chain**
- **After axillary surgery**
- **Prophylactic bilateral / contralateral mastectomy**
- **Inflammatory breast cancer**

Oxford		
LoE	GR	AGO
3	C	++
2b	B	+
3b	C	+/-
4	D	-
2b	B	-
3b	B	+/-
3b	B	--
3b	C	-

# Sentinel Lymph Node Excision (SLNE) Marking



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- **<sup>99m</sup>Tc Kolloid**
- **Preoperative lymphoscintigraphy (added information limited, but mandatory by legal regulations)\***
- **Patent blue dye**
- **Indocyanin green (ICG)<sup>o</sup>**
- **SPIO<sup>#</sup>**
- **Methylene blue**

Oxford		
LoE	GR	AGO
1a	A	++
1b	A	+
1a	A	+/-
2a	B	+
2a	B	+
2a	B	+/-

\* In Germany required for quality assurance of nuclear medicine

<sup>o</sup> no approval for LN marking in the axilla, off-label

<sup>#</sup> SPIO: Superparamagnetic Iron Oxide (Caveat: impaired MRI-sensitivity during follow-up)

# Begin of Adjuvant Therapy after Primary Surgery



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- **Start adjuvant systemic therapy and radiotherapy (RT) as soon as possible (asap) after surgery**
- **Start of adjuvant chemotherapy +/- HER2 therapy asap after surgery, prior to RT**
- **Without cytotoxic therapy +/- anti-HER2 therapy:**
  - **Start adjuvant RT within 6-8 weeks after surgery**
  - **Start endocrine therapy after surgery asap**
  - **Endocrine therapy concurrent with RT**

Oxford		
LoE	GR	AGO
<b>1b</b>	<b>A</b>	<b>++</b>
<b>1b</b>	<b>A</b>	<b>++</b>
<b>2b</b>	<b>B</b>	<b>++</b>
<b>5</b>	<b>D</b>	<b>++</b>
<b>2b</b>	<b>B</b>	<b>+</b>

# Neoadjuvant Systemic Therapy Loco-regional Surgery (Breast)



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	Oxford		
	LoE	GR	AGO
■ Pretherapeutic discussion in a multidisciplinary tumor board (e.g. to define the surgical procedure)	1a	B	++
■ Early marking of tumor (incl. detailed topographic documentation)	5	D	++
■ Surgical removal of tumor / representative excision of posttherapeutic, marked tumor area	2b	C	++
■ Tumor resection in new margins	2b	C	++
■ Microscopically clear margins	2a	B	++

# Neoadjuvant Systemic Therapy

## Indications for Mastectomy

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- **Positive margins after repeated excisions**
- **Radiotherapy not feasible**
- **In case of clinical complete response**
  - **Inflammatory breast cancer (in case of pCR)**
  - **Multicentric lesions**
  - **cT4a-c breast cancer**

Oxford		
LoE	GR	AGO
<b>3b</b>	<b>C</b>	<b>++</b>
<b>5</b>	<b>D</b>	<b>++</b>
<b>2b</b>	<b>C</b>	<b>+/-</b>
<b>2b</b>	<b>C</b>	<b>+/-</b>
<b>2b</b>	<b>B</b>	<b>+/-</b>

# Neoadjuvant Systemic Therapy

## Timing of Diagnosis, Surgery and Radiotherapy

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### Timing of surgery

4-8 weeks after last course of chemotherapy

### Radiotherapy within 2 months after surgery

Oxford

LoE	GR	AGO
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2a	B	++
----	---	----

2b	B	++
----	---	----