# Micro-CT Enables Margin Assessment of Full Tissue Surface in Breast Conserving Surgery Without Impeding Clinical Workflow

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# Breast Conserving Surgery

- Most common treatment for early stage breast cancer
- When combined with radiation therapy it is shown to be an effective treatment provided that margins are free of malignancy
- Unfortunately, 15-35% of women require a second operative to remove residual malignancy
- Need for better intraoperative tools!

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https://www.news-medical.net/health/What-is-a-Mastectomy.aspx

# **Clinical Trial**

- Lumpectomy Specimen Margin Evaluation With Tomography and Structured Light Imaging
- ClinicalTrials.gov Identifier: NCT04257799
- Currently open and actively enrolling patients
- 45 patients imaged for this study

#### Dartmouth Hitchcock Medical Center



### System at Outpatient Surgery Center:





# Clinical Trial Timing

- Image whole resected specimens at the time of surgery for the first time
- 3-4 minutes for micro-CT acquisition and reconstruction
- Data collection on information from surgery, radiology, and pathology



### Intraoperative Micro-CT Use

- Scans were read postoperatively but mimicking clinical conditions
- Two radiologists were given 5 minutes to make a margin status determination and measurements for all edges
- Could use any information they would have at the time of surgery (pre-operative imaging, results from biopsies, intraoperative x-rays, etc.)



Histology	No. of cases
IDCa low grade	9
IDCa intermediate grade	15
IDCa high grade	9
ILCa	10
Mucinous	2
DCIS	26
Pleomorphic LCIS	2

### Tumor histology from final pathology analysis for n = 45 patients

Margin	No of shaves
Superficial	0
Deep	3
Medial	2
Lateral	1
Cranial	1
Caudal	6

#### Anatomic margin for shaved margins

Energy	Current	Exposure Time of Detector	Number of projections	Beam Filtration	Field-of- View	Minimum detectable resolution
50 kVp	1 mA	100 ms /exposure	720	440 micrometer Aluminum filter	12cm x 12cm x 3cm	240 um

Scan parameters of the micro-CT system.







### **Intraoperative Micro-CT**

Caudal → Cranial		Superficial → Deep			
	Superficial			Cranial	
Medial		Lateral	Medial		Lateral
	Deep				
				Caudal	



### Pathology & Radiology

#### Pathology Report

Margin	Status	Tumor to Edge (mm)	Diagnosis
Superficial	Neg	6.4	ILCa
Deep	Pos	0.0	Final margin status
Medial	Neg	>10	Deep Positive
Lateral	Neg	>10	Primary tumor diameter
Cranial	Neg	>10	Pathology: 36.0 mm
Caudal	Neg	3.0	Radiologist 1: 25.0 mm

#### Radiology Micro-CT Report

Margin	Status	Tumor to Edge (mm)
Superficial	Neg, Neg	5.0, 2.3
Deep	Pos, Pos	0.0, 0.0
Medial	Neg, Neg	19.0, 14.4
Lateral	Neg, Neg	19.0, 17.5
Cranial	Neg, Neg	14.0, 16.3
Caudal	Neg, Neg	7.0, 5.4



	Radiologist Micro-CT 1 + Specimen X-ray	Radiologist Micro-CT 2 + Specimen X-ray	Std. Specimen X-ray
Sensitivity	0.40	0.50	0.30
Specificity	0.92	0.90	0.98
Accuracy	0.90	0.88	0.96
Positive Predictive Value	0.16	0.15	0.43
Negative Predictive Value	0.97	0.98	0.97
False Negative Rate	0.60	0.50	0.70

Statistical metrics of the performance of the imaging techniques





Distribution of true positive, false positive, true negative, and false negative cases broken down by margin.

### **Primary Tumor Dimension Comparisons**



## Relation to Surrounding Tissue Complexity



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### Conclusions:

- Feasibility of micro-CT for intraoperative use
- Micro-CT scans can be acquired and reconstructed in four minutes
- Scans can be read and measured in under five minutes
- Improved sensitivity to malignancy at the margin
- Decreased specificity
- All six margins can be analyzed
- Specimen compression is an issue
- Study done with experienced surgeon, would likely benefit other surgeons more



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### Thank you!

Questions?



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