

Optimizing breast conserving surgery by *ex vivo* ultrasound and radiological examination of breast cancer tissue

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Goals: We studied the role of *ex vivo* high resolution ultrasound and radiological examination of breast cancer tissue for the reduction of re-excision rate in breast conserving surgery. We also studied the relevance of additional excisions performed during the primary surgery according to the results obtained from tissue radiographs and tissue ultrasound *ex vivo*.

Background: Breast conserving therapy is the standard surgical approach for most patients with early breast cancer if negative margins are surgically achievable and adjuvant radiation of the breast is available.

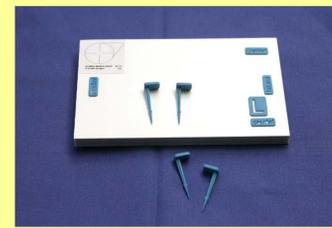
The cutoff point for negative or close margins is still under debate. Most institutions consider 3-5 mm a safe distance. If the pathological assessment of the excised tissue shows positive or low margins surgeons must perform re-excisions in order to achieve local control of disease. Since positive margins significantly increase the risk of local recurrence. There have been many attempts to identify subgroups of patients with a lower risk for local recurrence who could be spared from re-excision surgery even with positive or close margins.

The assessment of tumor margins in frozen sections of the excised tissue is being widely used, is time consuming, expensive and often not reliable. For this reason most guidelines do not recommend the use of frozen section evaluation or restrict its use to palpable tumors (20mm or more). With breast cancer screening programs established in many countries a considerable amount of non palpable tumors are being detected.

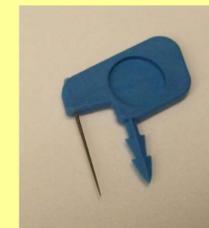
A better way to avoid re-excisions is to optimize the primary breast conserving surgery by using *ex vivo* high resolution ultrasound and radiological examination of breast cancer tissue and perform additional excisions during the primary surgery if necessary.

Methods: We developed a tissue transfer and X-ray system (T-TRAX) in 2008 which allows a topographic correct transfer of the tissue for *ex vivo* determination of tumor margins by radiologists and later by pathologist. T-TRAX reliably ensures precise localization of the tumor within the excised tissue by tissue-ultrasound and tissue-radiographs (anterior-posterior and cranio-caudal). The system is based on a non-opaque tray with radio-opaque topographic markers and safety pins designed to attach the excised tissue to this tray. Once pinned to tray by surgeons all examiners including the pathologists see the excised tissue as seen by the surgeons during surgery.

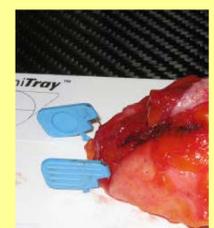
We evaluated the role of *ex vivo* high resolution ultrasound and tissue-radiographs for the reduction of re-excision rate in 214 cases of primary breast cancer undergoing breast conserving surgery. A high percentage of the tumors (58%) were 15mm or less in diameter (n=124). Additional excisions were performed during the primary surgery when tissue radiographs and tissue ultrasound indicated a low margin (less than 5mm). The margins defined by tissue radiographs were than compared to the histological findings and additional excisions were evaluated for being relevant or irrelevant for avoiding further surgery.



Tissue transfer and X-ray system T-TRAX



Short pin for tissue ultrasound



Tissue pinned to tray



Performing a Tissue radiograph anterior-posterior



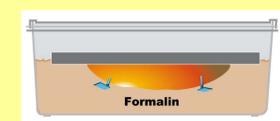
Cranio-caudal



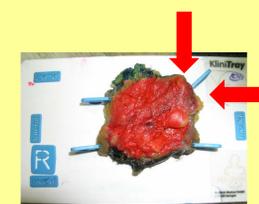
Tissue ultrasound



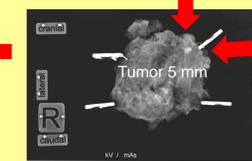
Ultrasound scan of tumor margins



Transfer to pathologists



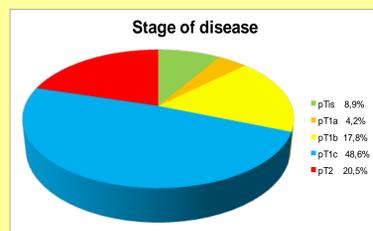
Tissue inked by pathologists in multiple colors to identify margins



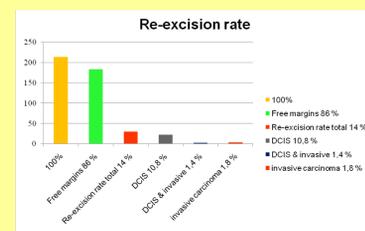
Tissue radiograph in ap low margins cranial & medial (arrows)



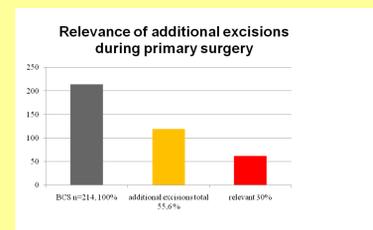
Tissue ultrasound of the tumor



Stage of disease in study population n=214



Re-excision rate for low margins (less than 5mm)



Relevant additional excisions during primary surgery 30%



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Results: In situ carcinomas accounted for 10.8% of re-excisions. Only 3.2 % of re-excisions were due to low margins for Invasive carcinomas.

Additional excisions during primary surgery according to tissue ultrasound and tissue radiographs were highly relevant (30%) for achieving free margins and reduced our re-excision rate significantly.

Conclusion: *Ex vivo* high resolution ultrasound and radiological examination of breast cancer tissue can help reduce the re-excision rate for low or positive margins significantly. Tissue-radiographs can furthermore improve communication between radiologists, breast surgeons and pathologists especially for multifocal disease and lesions smaller than 15 mm, provided that a standard tissue transfer and x-ray system is used.

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