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Research Article

Multidisciplinary Approach for Extreme Oncoplastic Surgery for Non Palpable and Extensive Breast Tumours using Bracketed Localization Technique

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Abstract

Oncoplastic breast surgery has become popular in recent years for high tumour to breast ratio, with recent studies showing equivalent survival, lower morbidity and better cosmetic outcome. Accurate preoperative localization of lesions is imperative, especially for multifocal, large non-palpable and pre-invasive lesions to obtain adequate oncological and cosmetic results. Image guidance assures the precision required for this purpose and needs close collaboration between the radiology team and surgeons. Our study analyses the feasibility of bracketed localisations for multifocal and large non-palpable lesions in extreme oncoplastic breast surgery.

Key words: *Localisation, Breast, Oncoplastic breast surgery, CWPF, Wires, Tag.*

Introduction

Oncoplastic breast surgery pushed the boundaries of conventional breast surgery which allows large area of pre-invasive and multifocal disease resection, whilst maintaining a good aesthetic outcome and patient satisfaction, thus improving the quality of life.(1,2,3,5,6)

Several reports have shown lower re-excision and mastectomy rates with no significant delay in initiation of adjuvant treatment because of immediate post-operative complications. (2,3,5,7) Additionally, on intermediate follow-up (up to 4.5 years) local recurrence rates were comparable with other studies. (55).

To contemplate oncoplastic breast surgical procedures a multidisciplinary team approach is imperative involving surgeons, radiologists and breast care nurses. According to several studies, the local recurrence after breast conserving surgery is directly correlated to surgical margin status (8,4,9,10). Hence, radiologist input is crucial for image guided preoperative localisation, especially for non-palpable T2/3, multifocal and pre-invasive cancerous lesions to improve both oncological and cosmetic outcomes(11,12,13). Surgeons need guidance to envisage three dimensional pictures while operating and this can be only possible by careful planning.

Conventionally, wire localisation(WL) has been used as a method for preoperative localisation of nonpalpable breast lesions since 1970s (14), with clear margins reported in a range of 70.8%–87.4% of cases(15). Often it is inserted via the shortest route and not been affected by incision, however in certain oncoplastic procedures such as chest wall perforator flap (CWPF) the focus should be avoiding the damage to the perforators.

Pre operative localization techinques have evolved with several non wire techniques which include Radio

guided Occult Localization, Radioactive seeds, Magnetic seeds, Radar reflectors, Radiofrequency tags. There is no significant statistical difference in the surgical outcomes of these devices. The technique selected should be the most accurate to localise the lesion or marker clip, thus facilitating the resection of tumour with adequate free margin, and possibly causing minimal to no discomfort to the patient.

In our department we use LOCalizer system by HOLOGIC Inc for wireless localizations . This technique uses a radiofrequency tag (RFID) and a hand-held reader for localization of non-palpable lesions during surgery. Each tag has its own unique serial number for identification. The localizer can be placed up to 30 days preoperatively and of late we have also used them in patients undergoing neo adjuvant chemotherapy. Similar to wires, for lesions more than 3 cm, two or more localisers can be placed to mark the extreme ends of the lesion. During surgery, the surgeon activates the reflector with the hand piece and follows the signal to guide the excision. The audible and numerical signals change with increasing proximity to the lesion. Once the tissue is removed, the reader console can be used to confirm that all tags have been removed from the tissue cavity and serial numbers are recorded.

Our primary aim was to study the feasibility of multiple localisation techniques for extreme oncoplastic breast surgery with high tumour to breast ratio for non-palpable lesions of more than 3cm. Our secondary aim was to evaluate the re-excision rates.

Methods

This is a single institutional study involving retrospective analysis from a prospectively maintained database with tumour size of more than 3 cm. The recruitment period is from September 2017 to February 2022.

The inclusion criteria are patients undergoing wide local excisions followed by either replacement or displacement oncoplastic procedures, with tumour size equal to or more than 3 cm requiring either bracketed wires or more than one tag for localisation. The exclusion criteria being, multiple localisations for excision biopsies.

The patient demographics, radiological localisation methods, histology, status of surgical margin, re-excisions, weight of resected specimen and complications were retrieved from the electronic record. Localisation accuracy rate was defined as wire or radiofrequency tag deployed within 10 mm of target lesion. The retrieval rate of wire or tag were also recorded.

Two methods of localisation were used for the duration of study; wire localization (Hawkins™ II BLN) from 2017 September to 2019 December and RFID from January 2020 to February 2022.

Pre-operative patient pathway:

Following diagnosis of non-invasive and invasive malignancy of breast, all patients were discussed in the multidisciplinary team (MDT) meeting. The potential patients with high tumour to breast ratio for oncoplastic procedures were identified in the MDT. The detailed discussion of imaging was carried out between radiologists and surgeons before consultation with patients. This included location and extent of disease and distance from the nipple. This is was recorded as 3D extent of lesion from superior to inferior, medial to lateral and anterior to posterior. This discussion allowed the surgeon to envision and understand the 3D dimension in relation to breast and also to calculate the tumour to breast ratio. This step was imperative because this allowed the surgeon to offer different options of breast operative procedures to patients.

For oncoplastic breast conserving surgery, surgeons assessed the patients for its suitability, and parameters considered were brassier & cup size, ptosis and frame of the patient. For replacement procedures such as chest wall perforator flap, surgeons also assessed the adequacy of tissue on lateral side of chest wall and upper abdomen with a pinch test.

General factors like co-morbidities and BMI were also considered before contemplating any operative procedures. Patients were given all possible options for breast surgery considered as oncologically safe procedures. If the patient consented to go ahead with oncoplastic breast conserving surgery, further in-depth discussion regarding the risks, operative time, recovery period and likely long term implications including symmetrisation surgery for displacement procedure were explained. Pre-operative and post-operative medical photography were prerequisite in all the cases and were part of the medical records.

Tumour localisation

Once a patient was consented for oncoplastic breast conserving surgery, a meeting with radiology collegues was arranged to discuss the image localisation technique and 3D lesion size. The antero posterior extension was considered less important, because conventionally breast tissue is dissected from mastectomy plain anteriorly to chest wall posteriorly. Calcification or distortion in the vicinity of the nipple was vital to know to make decision regarding nipple sparing. The lesion to nipple distance of more than 2 cm was considered feasible to preserve the nipple. Consideration was made to include satellite lesions, distortions, density and calcifications. Other factors to consider were the type of surgical procedures such as chest wall perforator flap, location and number of clip/s, targets for insertion of wires or tag, method of localization e.g; stereotactic or US guidance, skin marks and specific information on measurements required from post wire or tag insertion

mammogram. All this information was recorded on the proforma and filed in a designated folder. Annotations were also saved on PACS as key images to help the radiologist performing the procedure.

Image guided localization was performed with either mammographic or sonographic guidance using Hawkins wire from 2017 Sep to 2019 Dec and RFID from Jan 2020 to Feb 2022.

Bracketing technique was used for extensive disease, allowing targeted localization(54). The wires were marked with numbers (wire 1, wire 2 and so on) and its exact location in relation to the breast lesion was recorded. For lateral intercostal artery perforator or lateral thoracic artery perforator flap procedure, lateral approach for wire localisation was avoided to prevent damage to the vessels, similarly inferior approach avoided for anterior intercostal artery perforator flaps. In these circumstances the bracketing was challanging in some cases of wire localization as shortest skin to lesion distance was not chosen in order to preserve the vessels which made targeting difficult as the wire had to traverse a much greater depth then would be ideal.

In order to achieve the good surgical margins the surgeons required multiple measurements to create a 3D interpretation in their mind of the abnormal tissue.

Directly after the procedure, cranio-caudal (CC) and medio-lateral (ML) mammograms were obtained to confirm accurate placement (Figure 1). Skin marking with a permanent pen was also done to indicate site and depth of lesion if the localization was performed on the day of surgery to aid the site of surgical excision. In most cases the localization was done to bracket the extreme ends of the lesion either medial and lateral or superior and inferior.

The radiology report was written after careful examination of the pre and post localisation images. The distance between the lesion (marker clip) and localization device, its depth from the skin and in case of wire, the lenghth of wire outside the skin was recorded. RFID tag unique number was also documented.

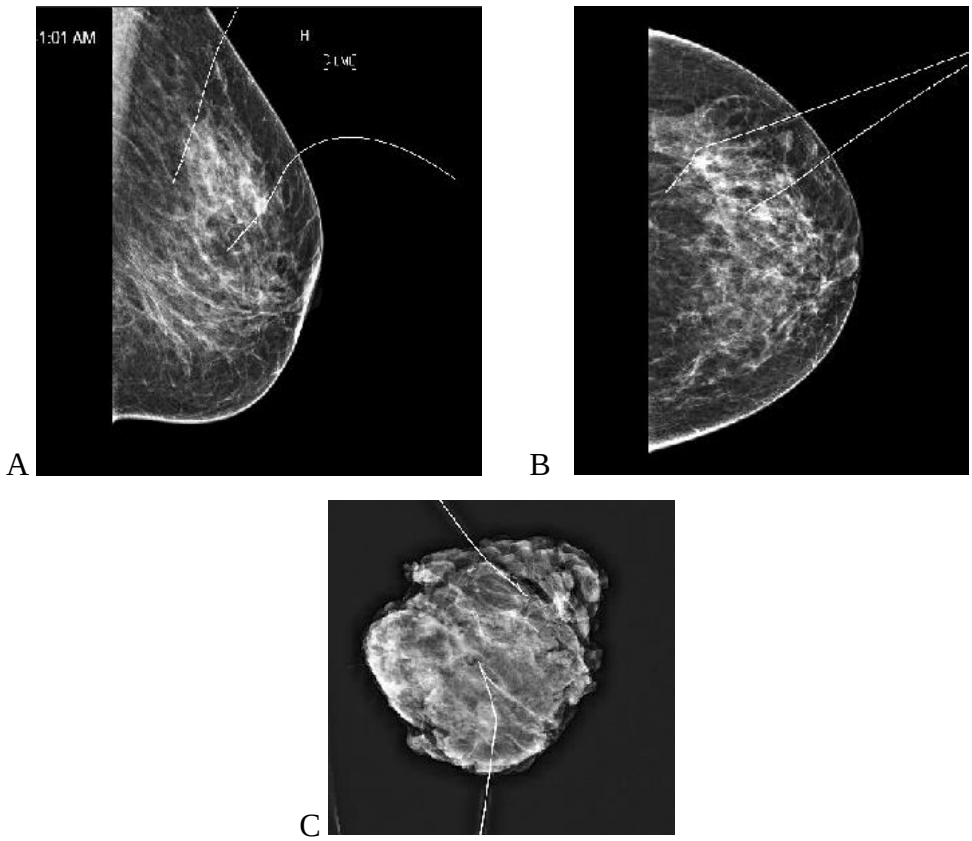

Figure 1: 51yr old with 31 BMI and BRA size 38 DD with multifocal DCIS measuring 50mm on pre op imaging, post op specimen weighed 150gm, tumerectomy with partial breast reconstruction lateral intercostal artery perforator flap. Margins clear. Mediolateral (A) and Craniocaudal (B) mammograms showing two bracketing wires marking the medial and lateral extent of disease. Specimen X ray shows radiologically clear margins (C).

Figure 2: 50yr old with 24 BMI, Bra size 34 B/C with Grade 1 invasive carcinoma measuring 31mm on pre op imaging, post op specimen weighed 58gm, tumerectomy and partial breast reconstruction with lateral intercostal artery perforator flap. Margins clear. Mediolateral and Craniocaudal mammograms showing two RFID tags marking the medial and lateral extent of disease.

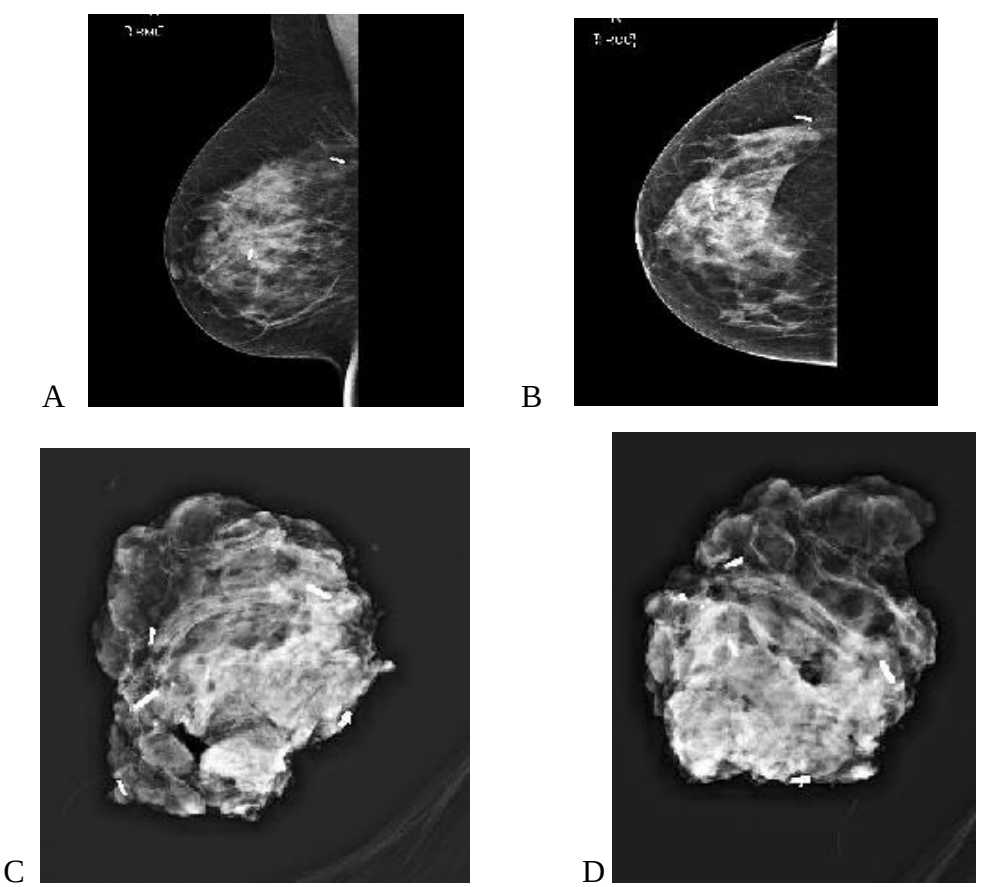

Figure 3: 63yr old with 24 BMI, Bra size 36 DD with invasive carcinoma measuring 66 mm on pre op imaging,

post op specimen weighed 129gm, tumerectomy and partial breast reconstruction with chest wall perforator flap. Margins clear. Mediolateral (A) and Craniocaudal (B) mammograms showing two RFID tags marking the medial and lateral extent of disease with specimen X rays shows radiologically clear margins (C,D)

Post operative specimen

The surgical specimen was X-rayed and reported by the radiologists. A verbal report was communicated to the surgeon at the same time and report included the presence of clips, tags or wires and radial margin adequacy. If any part of the abnormality was close to the margin, extra tissue was taken as a shave, where appropriate. Aim was to excise 1cm of macroscopically normal breast tissue.(49). It is our routine practice to take cavity shaves following tumerectomy.(50)

Results:

Between sept 2017 to Feb 2022, a total of 76 patients underwent more than one localisation procedure. The average size of pre operative tumour was 65.47 mm (total extent) with a range of (14-108 mm). 35 (45.45%) had multifocal/multicentric tumours and 41 (53.25%) had extensive calcifications. The breakdown of demographics and tumour details are shown in Table 1.

Table 1: Clinico-pathological characteristics of the study population

Characteristic	Number (percentage)
Pathology	
• Infiltrating Ductal Carcinoma- Not otherwise specified	39/76 (51.3%)
• Infiltrating Lobular Carcinoma	12/76 (15.8%)
• Ductal Carcinoma in situ	
• Other histologies	24/76 (31.6%) 1/76 (1.3%)
Stage	
• Tis	26/76 (34.2%)
• I	14/76 (18.4%)
• II	30/76 (39.5%)
• III	6/76 (7.9%)
Nodal status	
• Positive	15/76 (19.7%)
• Negative	36/76 (47.4%)
• Not applicable (DCIS)	25/76 (32.9%)

Grade distribution:	
• Grade 1 • Grade 2 • Grade 3 • NA	5/76 (6.6%) 36/76 (47.4%) 11/76 (14.5%) 24/76 (31.5%)
Hormone receptor positivity:	
• ER/PR Positive • ER/PR Negative • NA	48/76 (63.2%) 13/76 (17.1%) 15/76 (19.7%)
Her 2 Neu status:	
• Her 2 Neu positive • Her 2 Neu negative • NA	12/76 (15.8%) 40/76 (52.6%) 24/76 (31.6%)
Neoadjuvant chemotherapy:	
• Yes • No • NA	12/76 (15.8%) 40/76 (52.6%) 24/76 (31.6%)
ACE (Adult Co-morbidity Evaluation) score:	
• ACE-0 • ACE-1 • ACE-2 • ACE-3 • Unknown	36/76 (47.3%) 13/76 (17.1%) 2/76 (2.7%) _ 25/76 (32.9%)

51 (68%) had wire guided localizations (39 patients had multiple wires inserted while 12 had a single wire with an ultrasound skin mark). 24 (32%) had radio-frequency tags placed for localization (21 patients had multiple tags placed while 3 patients had single tag in association with an ultrasound guided skin mark).

98.68% (75/76) localizations were accurate as judged by post localization mammography, i.e with in 10mm of target area. Only in 1 patient ultrasound guided tag placement was inaccurate and this was converted to stereo guided procredure, which led to accurate tag placement.

Wire and tag retrieval rate was 100 % and none of them were migrated. No patient had any localisation related complication; except that one patient needed an additional stereo guided localization procedure as ultrasound guided tag placement was not accurate.

The average specimen weight was 144.8 gms (range 23.6-671.2 gms) 67/76 (88%) had clear excision margins and 9/76 (12%) required re-excision. None were converted to mastectomy.

11/76 (14.47%) of the patients had postoperative complications, most of these were minor and were managed conservatively (seroma-2, haematoma-2 and wound breakdowns-2).

Discussion

It is undemanding to resect a unifocal or palpable tumour with less tumour to breast ratio, however for multifocal, non-palpable tumours and DCIS, it is valuable to know the likely radial margins for resection. Detailed planning with the radiology team cannot be overstressed for adequate tumorectomy and to avoid high rate of margin re-excision. Firstly, it is vital to assess the patients' suitability for breast conserving surgery with or without an oncoplastic procedure. Secondly, an appropriate localisation method needs to be planned to assist surgeons during operation, so as to create a 3-D picture of abnormal tissue. If the tumour is more than 3 cm then we recommend a bracketing technique with more than one localisation. It is not uncommon to have more than 2 localisations sometimes, especially, if the tumour appears to be triangular in shape.

Localisation for oncoplastic procedures requires added time to plan, perform and report these cases. In our study, accurate localization was achieved in 98.68% of the cases. Retrieval rate was 100%. All cancers were confirmed on the final histology and 25 (33%) patients had complete pathological response after neoadjuvant chemotherapy. So, the success rate for multiple localisation for non-palpable tumour was 98.68%. These results are in agreement with other published literature.(27,28,29,30)

Although Wires have been the mainstay of pre-operative localisation, they have many disadvantages including vasovagal reaction, migration within and outside the breast, transection of certain types of wires during surgery with pieces being retained in the breast (23,24,25,26). The procedure in itself is unpleasant and requires greater compliance from patients, as wire must remain in position until surgery is performed. Moreover, this localization has to be performed on the day of surgery to avoid displacement and therefore requires adequate coordination between breast radiologists and surgeons. This can lead to inconvenience and inefficient utilisation of the theatre list. Sometimes, wire localisation could limit the surgical approach and potentially affect cosmetic outcome. For certain oncoplastic procedures such as chest wall perforator flap especially during one stage procedure(51,53)one should avoid lateral approach otherwise this might compromise lateral intercostal vessels.

Newer techniques have developed over a period of time to mitigate some of the risks of standard wire localisation techniques including non-target tissue removal. Some reported issues which are similar to any localisation techniques are haematomas(39,39) resulting in difficulty in obtaining signal from the device(40) and migration of device on release of breast from compression during the stereotactic guidance(41,43). In our study we report no serious complications due to localisation. 11/76 (14.47%) patients had postoperative complications. No patient had migration of tags or wires. Only 1 patient needed further localisation with

stereo-tag because of inaccurate placement of tag by ultrasound.

Use of tag from Dec 2020, has improved our theatre efficiency and time management in our services, as well as patients' quality of life; since these do not necessarily require insertion on the day of surgery(48).

Nonetheless, good communication prior to surgical date with well-illustrated diagrams and annonated mammographic images is necessary to mitigate the risks, as the radiologist planning the procedure with the surgeon may not be the one performing the localization.

The primary aim of our localization of multifocal and non-palpable tumours is removal of lesions with margins free of disease. To facilitate the same, the intra-op specimen X ray, frozen section or margin probe will aid to ensure adequate margin excision. (33,34,35)

Although there is no consensus across the globe, about what defines the clear margin, we accept 1mm free from the tumour as acceptable margin for both invasive and pre invasive tumours (37). Our study shows margin excision in oncoplastic breast surgery with multiple localisation techniques is comparable to other studies irrespective of localisation techniques. Some studies have shown that the presence of ductal carcinoma in situ is one of the factors that increases the number of cases with positive surgical margins regardless of the localization method used(31,46,47). In our study the margin excision rate for tumours with both invasive and DCIS components and for pre-invasive tumours was 12%. When comparing non wire localisation techniques and wire localization techniques, some studies have shown positive margin or re-excision rates is slightly lower with former, however, it was not statically significant (36,40,42,44,45).

In our study the margin excision rates for wire localisation was 14.8% (8/54 patients) and for RFID was 4.54% (1/22 patients) which was not statistically significant (P value- 0.1).

The limitation of this study is that it is from a single centre where a high volume of non-palpable lesions undergo breast conserving surgery with oncoplastic technique, unlike in other centres where many of these patients would have been treated with mastectomy. Experienced radiological and surgical team is imperative to localise these lesions to provide the extreme oncoplastic services for breast conservation respectively. The future aim is to study the cost effectiveness of RFID localisation technique and patient reported outcome to have some objective measurement for cosmetic outcome for both wire and RFID localisation.

Conclusion

A multidisciplinary team approach is essential to facilitate extreme oncoplastic breast conserving surgery for the management of large non-palpable lesions using bracketing image guided techniques. This allows large area of pre-invasive and multifocal disease resection, whilst maintaining a good aesthetic outcome and patient

satisfaction, thus improving the quality of life. Several reports have shown lower re-excision and mastectomy rates.

Newer non wire localization devices such as RFID are promising and more effective with similar outcomes compared to wire guided localisation techniques.

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