

# Can The Charcoal Localization For Surgical Resection of Non-Palpable Breast Suspicious Lesions Be a Promising Method For Communities of Low Resources? Retrospective Observational Study.

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## Research Article

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# Abstract

**Background:** Breast cancer is more frequently being detected as radiographic non-palpable lesions with the increased utilization of national screening programs. Moreover, the sizes of tumors detected have decreased in recent years, increasing the need for the accurate image-directed localization for surgical excision in a significant portion of cases. Although Wire guided localization has been the most commonly used method for many years, but inherent problems remain and limited its practice. Radio-guided occult lesion localization (ROLL) is currently the standard method of localization, however it is unavailable in most of low resources communities. This encourages us to use charcoal localization which is simple and cheap method of surgical localization of non-palpable suspicious breast lesions.

**Methods:** This prospective study included 34 patients presented with non-palpable suspicious breast lesion (BIRADS 4 or 5). All patients were injected with 1-3 ml of sterilized 3% aqueous suspension of charcoal granules under guidance of ultrasound at the superficial border of the suspicious lesion and the track between the lesion and the needle entry point in the skin which occur at the future incision. This method was carried out in most patients one day before operation, however two patients underwent surgical excision after 6 days of localization without any interruption.

**Results:** Thirty four patients had 36 Lesions. The median age was 43 years. The mean diameter of lesions 10.9 mm. Out of 36 lesions; the BIRADS as follow 10 (4a), 12 (4b), 8 (4c), and 6 (5). Postoperative revealed 16 malignant lesions and 20 benign lesions. All 20 benign lesions were managed by wide local excision; All 14 BIRADS 4a lesions were proved to be benign. Sixteen malignant lesions were managed as the following; nine patients had breast conserving surgery, five patients had modified radical mastectomy (three patients had past history of modified radical mastectomy, one patient had Multicentric ILC and one patient had infiltrated safety margins on conservation), and one patient had Nipple Sparing Mastectomy with immediate breast reconstruction by Latissimus Dorsi Flap . There was no reaction nor infection reported in our study.

**Conclusion:** Charcoal localization has many advantages and help surgical localization.

## Introduction

Breast cancer is considered is the commonest cancer among females. About 25% - 35% of breast cancers are non-palpable at the time of diagnosis [1].

With the increased utilization of national screening programs, breast cancer is more frequently being detected as radiographic non-palpable lesions up to 50 % [2, 3].

Moreover, the sizes of tumors detected have decreased in recent years, increasing the need for the accurate image-directed localization for surgical excision in a significant portion of cases, because precise localization of non-palpable lesions is an essential step to guarantee cancer clearance without compromising cosmetic results [4].

Various techniques have been trialed for accurate localization of non-palpable breast lesions; each with some advantages, risks and disadvantages.

Wire guided localization (WGL) was the standard and the most commonly used localization method for non-palpable breast cancers during the 1990s in the absence of better alternatives [5], however this method is far from ideal and it has several disadvantages.

Scheduling conflicts between the surgeon and the radiologist can occur, resulting from the need to coordinate multiple procedures on the same day list with different teams. There is an inability to use wire localization for the first start time in the morning without a significant delay in the operating room [6]. In addition, the procedure necessitates surgical excision within very short interval after wire placement [7]. The physical presence of a wire within the operative field can result in a more complicated incision and make the procedure of surgical excision with clear margins technically difficult.

Moreover, there remain serious problems which are encountered like; displacement, difficult re-positioning and sometimes interference with the surgical approach itself. The wire may become displaced, migrate or be transected especially during mobilization of the patient [8, 9]. Repositioning can be complicated by bruised tissue within the previously punctured tumor site [10].

Wire placement is technically challenging with significant difficulty, especially in dense breast tissue.

The relatively high cost of WGL (greater than US\$100) for tumor localization compared with other techniques has proven to be prohibitively expensive for its implementation in many developing countries [7, 11, 12].

Radio-guided occult lesion localization (ROLL) or radioactive seed localization (RSL) is a technique utilizing a radio-pharmaceutical tracer which is injected in the lesion and which is commonly used for lymphatic mapping and sentinel node biopsies. In the same surgical procedure, the tracer can be used to localize the primary tumor guided by a gamma probe.

Based on the literature, compared to conventional WGL, the ROLL technique seems to be faster, more accurate, more comfortable, and it provides a better cosmetic result and higher percentage of tumor free margins in the case of cancer patients [13, 14, 15]. However, this method is unavailable in most of low resources communities

Till now there is no agreement about the most appropriate or standard method of surgical localization. This encouraged us to use Charcoal aqueous suspension under ultrasound guidance. The aim of this study was evaluation of the effectiveness and outcome of charcoal localization for surgical resection of non-palpable suspicious breast lesions in communities of low resources

## Patients And Methods

This is a prospective single cohort observational effectiveness study. It was carried between July 2015 and May 2018, at Oncology Center-Mansoura University (OCMU), Egypt. The design of this study was approved by the Institutional Research Board (IRB) of the Faculty of Medicine in Mansoura University and written informed consents were obtained from all patients before enrollment.

## **The sample target and inclusion criteria:**

All patients enrolled in this study were diagnosed with suspicious breast lesion(s) either BIRADS 4 or 5 by breast ultrasound with or without mammography according to the age of patients. The exclusion criteria were women who had breast lesions BIRADS 1,2 and 3, and patients who had a known history of drug hypersensitivity.

## **Localization technique:**

After identification of the suspicious breast lesion by radiologist using a real time ultrasound and injection of local anesthesia, 1-3 ml of sterilized 3% aqueous suspension of activated charcoal granules (Figure 1) was slowly injected under ultrasound guidance at the superficial margin of the suspicious lesion (Figure 2) & forming a track between the suspicious lesion and the point of needle entry in the skin (Figure 3).

We have used a 20-ml syringe with 20-gauge needle (Figure 1) in order to prevent blockage by charcoal particles and during the procedure, the assistant nurse kept shaking the charcoal bottle to prevent settling of charcoal granules. The amount of injection depends on the number and depth of suspicious lesion(s) which should be sufficient to make an easily intraoperative identifiable track.

The point of needle entry in the skin after charcoal localization acquired the black color of charcoal and remained fixed till surgery (Figure 4). This point was selected carefully and individually tailored according to the location and depth of the suspicious lesion, in order to facilitate the choice of skin incision and surgical procedure. To facilitate the intraoperative lesion identification; the following data were recorded in the localization report; depth of lesion, needle direction during injection, and the angle of insertion with the skin.

## **Surgical resection**

The charcoal track was followed by dissection till reaching the superficial margin (Figure 5), then the breast tissue containing charcoal was excised all around with surgical safety cut at least 1cm (Figure 6), but in the depth it depended on the extension of the lesion that was described by preoperative ultrasound.

After removal of the specimen, the remaining margins were landmarked (Figure 7) and send to intraoperative frozen section analysis.

All patients with benign results or breast conserving surgery for malignant results were followed up by ultrasound at 6 months after surgery in order to detect any suspicious lesions at the site of resection.

## Results

This prospective study included 34 patients presented with non-palpable suspicious breast lesion (BIRADS 4 or 5). The median age was 43 years (range; 36 - 50). Ten patients presented with positive family history of breast cancer and three patients had past history of breast cancer and were treated with modified radical mastectomy within 2 years ago.

Two patients presented with bifocal lesions, so 34 patients had 36 lesions. Out of those 36 lesions; 10 lesions were BIRADS 4a, 12 lesions were BIRADS 4b, 8 lesions were BIRADS 4c and 6 lesions were BIRADS 5. The largest diameter of these lesions ranged between 4 - 15 mm (Mean 10.9 mm).

Postoperative pathologic results revealed 16 malignant lesions (Figure 8) and 20 benign lesions; 15 Fibroadenosis with epitheliosis (Figure 9), 3 Fibroadenomas, one fibroadenomatoid hyperplasia, and one sclerosis adenosis. All 20 benign lesions (in 19 patients) were managed by Wide Local Excision.

The pathologist did not report any more difficulties due to the charcoal injection in the issue of histopathological assessment of the post excisional biopsy

Sixteen malignant lesions (in 15 patients) were managed as the following; 9 patients had breast conserving surgery with free all surgical margins proved by both intraoperative frozen section analysis and postoperative paraffin section analysis, 5 patients had modified radical mastectomy (3 patients of them had past history of modified radical mastectomy for contralateral breast cancer, one patient had multicentric ILC and one patient had infiltrated safety margins on conservation), and one patient had Nipple Sparing Mastectomy (NSM) with immediate breast reconstruction by Latissimus Dorsi flap (Figure 10), due to failure to achieve free safety margins in conservation.

Localization was carried out in most patients one day before operation, However, two patients underwent surgical excision after 6 days of localization without any interruption during surgery. There was no reaction nor infection reported in our study. Charcoal staining did not interfere with histopathologic examination which could be carried out without any difficulties (Figures 8&9)

Breast ultrasound follow up at 6 months after surgery for benign results (19 patients) or breast conserving surgery for malignant results (9 patients), did not detect any suspicious lesions.

## Discussion

The breast cancer is considered as the 1st malignant tumor affecting our females in Egypt, as in all over the world and also as improvement of the screening programs and awareness of the importance of these programs aiming for the early diagnosis of cancer breast at early stage for better cure rate another challenge had become evolved that is how to deal with the impalpable suspicious breast lesions deserving tissue biopsy. Many techniques had been tried for preoperative locating of the non-clinically detected suspicions lesion depending on the availability of tools and experience of the doctors (16).

Nearly all these techniques rely on the cooperation of both surgeon and the radiology team. the most popular techniques include, wire localization, radioactive guided material seeding within the occult lesion, superficial skin mark, intraoperative u.s guidance, radioimmuno- guided location, magnetically detected lesions and dye detection such as blue dye or aqueous charcoal detection. With practice some disadvantages had been appeared for these techniques as in case of the wire localization the insertion of the wire should be within short time from surgery best immediately send the patient for O.R. after localization this is hardly possible to arrange between both surgery team and radiology team for this task (6) many other complication had been noted such as displacement or broken wire (8) another problem is the emigration of the wire up to it may make chest trauma (17,18) also intraoperative the wire may be inside the tumor make it removed with less radical or make thermal injury to the skin or limited skin incision (6) also there is failure rate about 18% of the localization (19) regarding the other newly techniques that depend on the radioactive materials, they need more cost and experience. also this technique need more communication between the radiologist, team of the nuclear medical team and surgery one for injection of the radioactive material at the lesions and need special equipment (19) so some prefer to save this effort and cost for cases of preoperative biopsied lesion as a malignant one e.g.by cytological to get benefit from doing radiolabeled tracing of the mass and sentinel lymph node not for lesion may be benign. Another technique is Magnetic guided tumor location which has drawback, as a surgeon you are guided to remove the tissue marked by the magnetic tracer which not always that of the tumor need more cooperation between the surgeon and radiologist for accurate detection of the tumor (3). IN our country, as in other countries with limited income all these high cost techniques are not easily available and also should be saved for needed cases e.g. cases in need for sentinel lymph node biopsy so we in our center started to another applicable technique with less cost and good result one of most promising one is the aqueous charcoal injection in the suspicious lesion the excision of the marked areas and our result showed that technique is better than other dye dependent e.g. blue dye as the blue dye will disperse in the tissue while this is accurately limited to the tumor this results are in harmony with that of H.A. MOSS et al 2002 ( 19 ) and very little better than of ROSE group (21) as they has .9% missed lesion in the arm of charcoal localization. also we totally agree with the advantage that group had been concluded that the advantages of charcoal localisation include short course of training curve, least cost in comparison of its accurate result, patient comfort, less tissue removal with availability of good cosmosis with constant charcoal tract (21) also our results show no increased risk for wound infection as we used sterile solution but at end due to small sample we advise repetition of the work with larger sample.

Few studies in the literature denoted that there is some debate about the impairment of difficulty in the interpretation of histopathological assessment of lesions labeled with coal suspension but in our study no difficulty was detected in that issue ( 22) in our work we totally agree with that result of CAVALCANTI and her work (22)as no detected change in the pathology of lesions

## Conclusion

Charcoal localization for surgical resection of non-palpable suspicious breast lesions has some technical superiority, being due to; accurate & rapid. No tissue dispersion (because activated charcoal is in particulate form and water insoluble, so it remains within the injected track). The stability of charcoal marking over time is one of its major advantages, therefore the tracing of the charcoal tattoo during surgery makes it easy to locate the lesion, which means that surgery can be planned over a period of many days. No reaction reported (charcoal is biologically inert). No need for particular equipment or instruments. Low cost. No interference with histopathology

## **Declarations**

All the author confirm the following

### **Ethics approval and consent to participate**

The work had been approved by the local ethical committee in the oncology center before start of work and all patient had been consented to be enrolled in the study

### **Consent for publication**

All the participant in the study gave consent for using the data in publication

### **Availability of data and materials**

We give the consent for using the all data and materials for publication

### **Funding:**

Author(s) disclose no funding sources.

### **Competing Interests:**

Author(s) disclose no potential conflicts of interest.

### **Authors' contributions**

Omar Farouk the planning of the research and design of study

Omar Farouk , Mohamed Ezzat , Tamer Fady, Ahmed Abdallah ,Nazem Shams and Ahmed Senbel all participate in the surgical work

Omar Farouk , Mohamed Ezzat draft writing

Ahmed Senbel finalizing of writing and editing

Tamer Fady, Ahmed Abdallah ,Nazem Shams revision of editing

Adel El-Badrawy localization of mass by u.s and charcoal injection

Wagdi El-Kashef pathological examination of the specimen

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## Figures



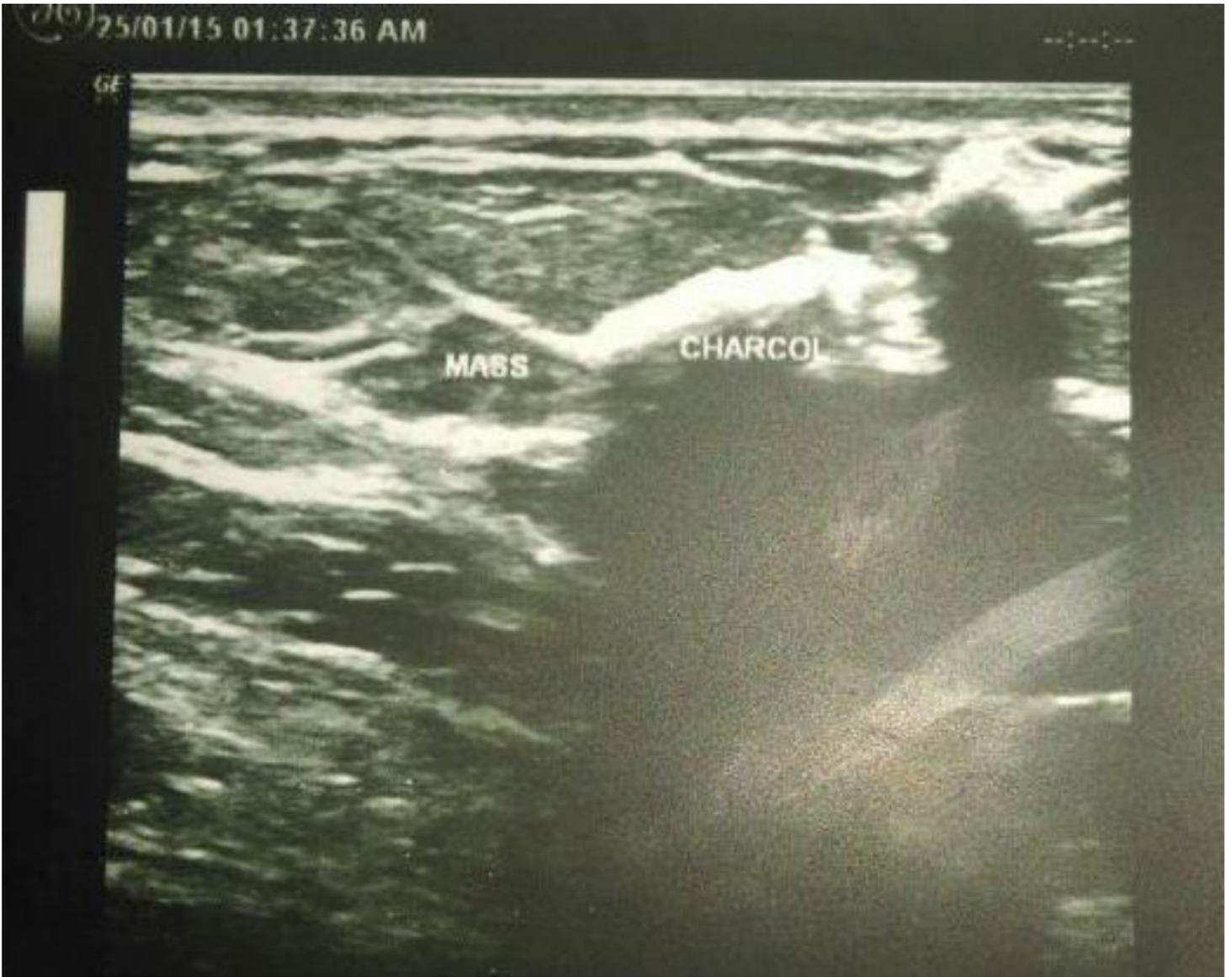
**Figure 1**

1-3 ml of sterilized charcoal suspension was aspirated using a 20-ml syringe (in order to prevent blockage by charcoal particles)



**Figure 2**

ultrasound guided injection of charcoal at the superficial margin of suspicious lesion BIRADS 4a measured 5.5X4 mm in patient aged 36 years with positive family history of breast cancer. Postoperative pathology revealed fibroadenosis, see figure (9).



**Figure 3**

ultrasound picture after injection of charcoal at the superficial margin of suspicious lesion BIRADS 4b measured 12.5X6 mm & forming a track between the suspicious lesion and the point of needle entry in the skin in patient aged 41 years with positive family history of breast cancer.



**Figure 4**

The point of needle entry in the skin after charcoal localization acquired the black color of charcoal and remained fixed till surgery



**Figure 5**

The charcoal track was followed by dissection till reaching the superficial margin



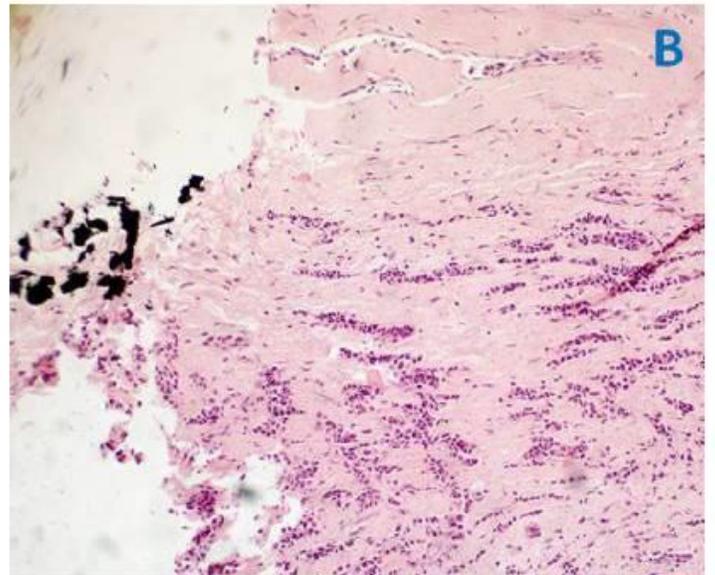
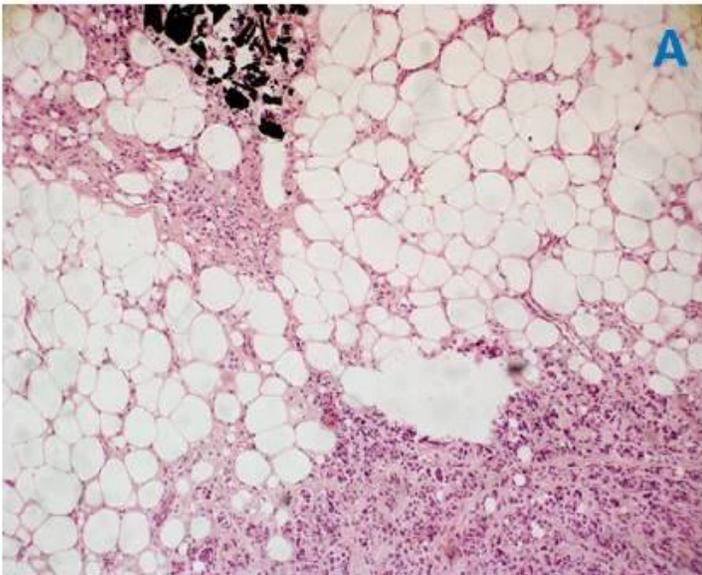
**Figure 6**

The breast tissue containing charcoal was excised all around with surgical safety cut at least 1cm, but in the depth it depended on the extension of the lesion that was described by preoperative ultrasound.



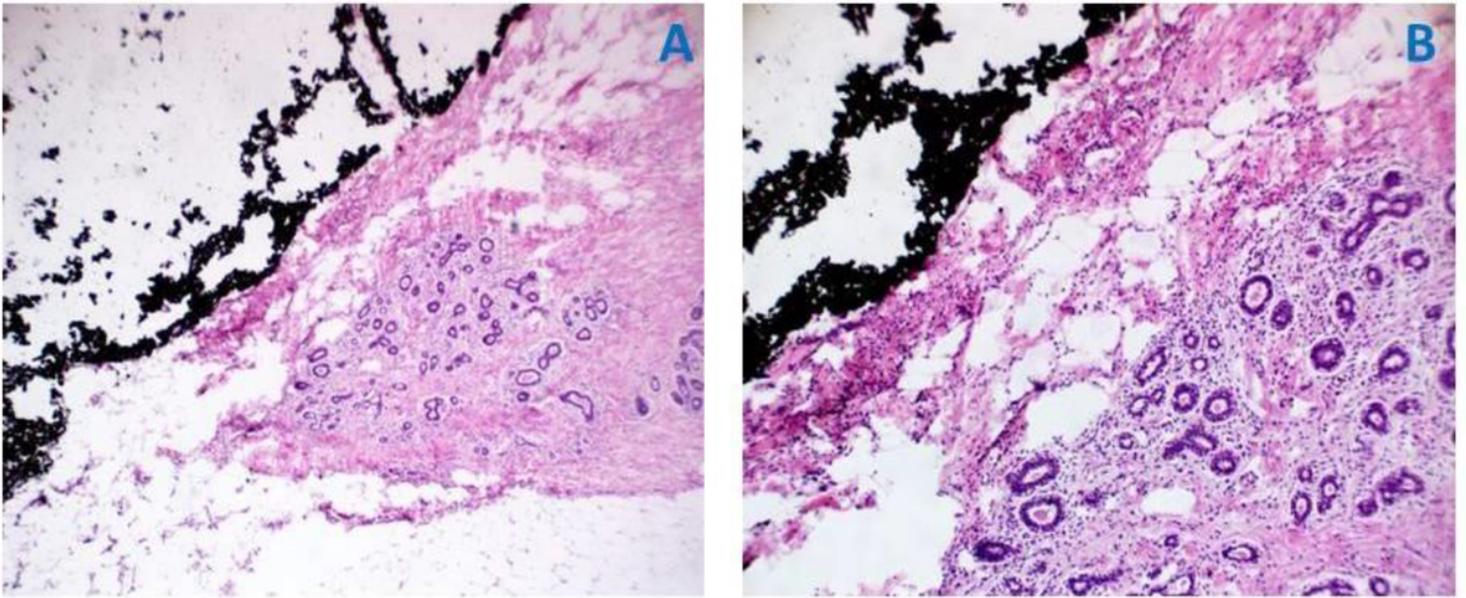
**Figure 7**

After removal of the specimen, the remaining margins were landmarked and send to intraoperative frozen section analysis



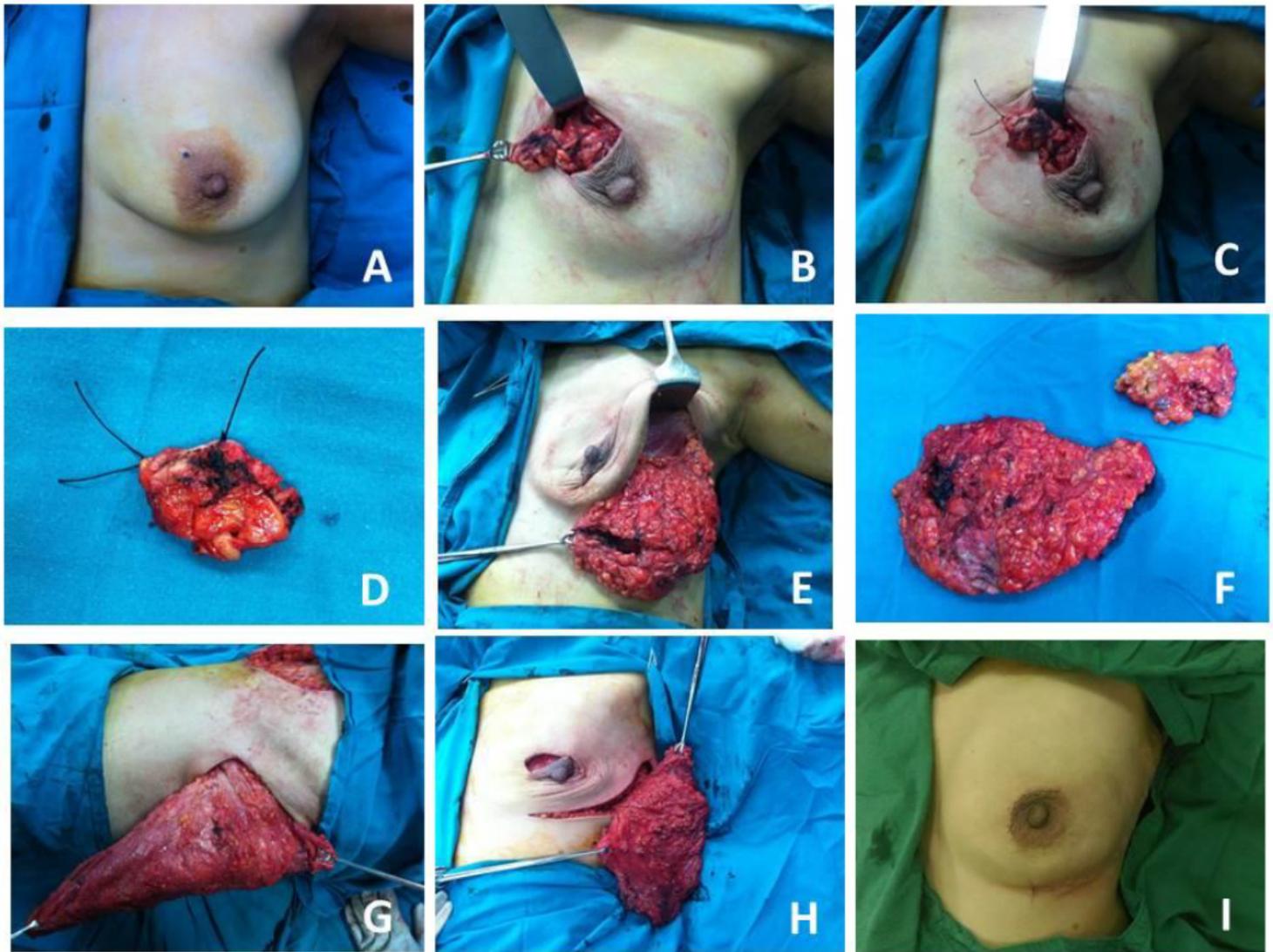
**Figure 8**

Malignant lesions with Charcoal localization.



**Figure 9**

Fibroadenosis with epitheliosis with Charcoal localization. Charcoal staining did not interfere with histopathologic examination which could be carried out without any difficulties



**Figure 10**

One patient had Nipple Sparing Mastectomy (NSM) with immediate breast reconstruction by Latissimus Dorsi flap, due to failure to achieve free safety margins in conservation.