

Wire-guided Localization in Non-palpable Breast Cancer: Results from Monocentric Experience

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Abstract. *Background: Breast-conserving surgery (BCS) is considered the gold-standard treatment for early breast cancer. Ultrasound-guided percutaneous biopsy or stereotactic biopsy of a breast lesion allows preoperative histological diagnosis. Various techniques have been proposed for identifying non-palpable breast tumors, but the most popular method is the wire-guided localization (WGL) technique. The aim of this study was to propose an alternative technique for optimizing the WGL procedure, facilitating breast surgery and reducing complications. Patients and Methods: We performed a prospective study on 40 patients with a single non-palpable breast lesion. For the preoperative localization of mammary lesions, patients were divided randomly into two groups: 20 patients underwent conventional WGL technique and 20 underwent 'optimized' personalized technique. Results: In the group treated with the optimized technique, dislocation of the wire occurred in only 2/20 cases, whereas in those with the conventional technique, dislocation occurred in 9/20 cases ($p=0.03$). In 5/20 cases of the conventional WGL technique, the wire was accidentally cut by the surgeon, whereas no similar complications were observed in the group that underwent the optimized technique ($p=0.047$). Re-excision of the surgical margins was necessary in 6/20 cases with the conventional technique, while re-excision was not required for any case using the optimized technique ($p=0.02$). Conclusion: The proposed optimized technique ensures good esthetic results, enabling the surgeon to identify the lesion and perform oncoplastic breast surgery, and allows surgical time to be reduced.*

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The number of patients with non-palpable lesions of the breast has gradually increased (1, 2). This is due to the early detection of these lesions with screening programs and to the technological development in imaging techniques [breast ultrasound, X-ray mammography, breast tomosynthesis, breast magnetic resonance imaging (MRI)] (3-6).

In early detected non-palpable breast cancer, breast-conserving surgery (BCS) with adequate resection margins is considered the gold-standard surgery (7-9), and various techniques have been proposed for preoperative localization of the non-palpable lesion (10, 11) in order to achieve optimal surgical treatment (8), as we already highlighted in breast sarcomas (12, 13). A relatively new preoperative localization technique for non-palpable early breast cancer is radioguided occult lesion localization (ROLL) (14-16) and its evolution, sentinel node and occult lesion localization (SNOLL) (17), two techniques aimed at intraoperative localization of occult neoplastic lesions and at both reliable breast lesion and sentinel lymph node identification, respectively.

Nevertheless, the wire-guided localization (WGL) technique represents the method most used by surgeons (10). This procedure can easily be performed under ultrasound or mammography guidance, and provides real-time control of the wire-needle position, allowing accurate location of the lesion (16, 18). Most frequently, the technique consists of ultrasound-assisted introduction of the guide wire. The mammography-assisted procedure is performed in cases of breast microcalcification (10). MRI-assisted WGL is performed only in special cases due to the high costs of this method (11).

An ideal intraoperative procedure for precise location of non-palpable breast lesions should allow the surgeon to perform a complete single surgical session excision, avoiding excessive removal of normal glandular tissue and without compromising cosmetic results.

The aim of this study was to propose an alternative personalized technique for optimizing the procedure of radiological-assisted WGL for detecting non-palpable breast cancer, facilitating breast surgery, and reducing complications.

Patients and Methods

Patients. A prospective study was conducted on patients with a single non-palpable breast lesion, referred to the Department of Radiological Sciences, Sapienza - University of Rome, Italy, in the period between January 2012 and February 2014. Written-informed consent was obtained from the patients and all procedures were in accordance with the ethical standards of the local responsible Institutional Committee on Human Experimentation and with the Helsinki Declaration of 1975, as revised in 2000. Exclusion criteria were: patients who had already undergone breast surgery or radiation therapy, those with extensive microcalcifications and those with multifocal breast lesions. Moreover, breast inflammation was an exclusion criterion, as previously assumed (19).

Patients were studied with mammography and breast ultrasound examination and underwent preoperative percutaneous biopsy or fine-needle aspiration to obtain a histological/cytological diagnosis.

Localization of the breast lesion. The conventional ultrasound-assisted WGL method allows a good visualization through the positioning of the probe above the lesion and an easily visible introduction of the wire guide, with real-time control of the wire-needle position (10).

In our 'optimized' ultrasound-assisted WGL technique, the point of introduction of the wire guide was previously planned and agreed with the surgeon, according to the type of breast incision to be made, including oncoplastic technique (Figure 1). The wire guide was positioned along the major axis of the surgical excision or perpendicular to the underlying lesion if the depth of the lesion was <2 cm, with the intention of being as close as possible to the site of the surgical incision.

The localization of lesion was performed using ultrasound guidance with 10.5 to 12 MHz linear probe (Aplio XV; Toshiba, San Jose, CA, USA) (Figure 2). The wire guides used for mammary localization were metallic (20 G × 75 mm; HS Hospital Service SPA, Aprilia, Italy).

The patients were randomly divided into two groups: 20 patients underwent the conventional WGL technique and 20 patients underwent the optimized WGL technique. In each case, the breast surgeon made a preoperative drawing according to the quadrant where the lesion was located; the ultrasound probe was positioned to assist the wire guide, allowing it to enter directly inside the preoperative drawing, within the breast's planned incision lines.

Surgery. All patients underwent breast quadrantectomy with excisional biopsy of the sentinel lymph node. For lesions located in the upper-superior quadrant, a radial external incision was performed, allowing the excision of the sentinel lymph node in the ipsilateral axilla from the same access of the quadrantectomy, and enabling a better esthetic result. For breast lesions located in other quadrants, a second skin incision of about 2 cm was performed for the sentinel lymph-node biopsy.

In patients presenting breast microcalcifications, a radiographic examination of the surgical specimen was carried out before histological examination.

Statistical analysis. Patients' characteristics were described using the mean±standard deviation for continuous normally distributed variables and percentages for dichotomous variables. Where applicable, chi-square test and Student's *t*-test (two-sample) were

used to calculate the *p*-values. A *p*-value lower than 0.05 was considered statistically significant.

Results

We performed a prospective study on 40 patients presenting a non-palpable breast lesion. The age of enrolled patients was from 41 to 76 years.

As diagnostical preoperative breast examination, mammography and ultrasound examination were performed, in some cases subsequently validated by breast MRI. The investigations documented in 26 cases of a lesion recognized according to the categorization of Breast Imaging Reporting and Data System (BI-RADS) as a BI-RADS 5 lesion and in 14 cases as a BI-RADS 4 lesion, highly suspicious for breast cancer (20).

The preoperative diagnosis of breast cancer was confirmed by cytological report in nine patients, while in 31 patients by histological report.

In the preoperative phase, the WGL technique did not cause complications to patients, such as bleeding, hematoma, infection or Mondor's syndrome, as reported in the literature (10, 21). The localization of the breast lesions was distributed as shown in Table I. Non-palpable breast cancer was identified and excised in all 40 patients.

As a parameter for evaluating the technical difficulties of the two different WGL methods, we considered the time spent for the execution of the procedure. The time spent for conventional ultrasound-assisted WGL was from 5 to 15 min, depending on the breast's characteristics and depth of the lesion, and the mean duration was 10±5 min. The mean duration of the optimized WGL technique was significantly longer at 13.7±5.1 min (*p*=0.02).

In both techniques, the most relevant intraoperative complications occurring during the surgical procedure were: dislocation of the wire, accidental cutting of the wire, and inadequate margin resection. Dislocation of the metal wire occurred in 11 cases out of the total 40 patients enrolled. In particular, in these cases, the wire guide was inserted vertically in the orthogonal direction of the surgical excision. In patients of the group that underwent the conventional technique, dislocation occurred in nine cases out of the 20 performed (45%). We recorded a lower rate of wire dislocation using the optimized technique (only two cases out of the 20 performed, 10%) (*p*=0.03).

Re-excision of the surgical margins was necessary in six cases (30%) out of the 20 patients who had undergone localization with the conventional technique. In particular, in one case (16.6%), the re-excision was necessary due to dislocation of the wire that resulted in inadequate excision of the breast lesion. In the other five cases (83.4%), re-excision was necessary because of the accidental cutting of the wire and consequent difficulties in the identification of the lesion

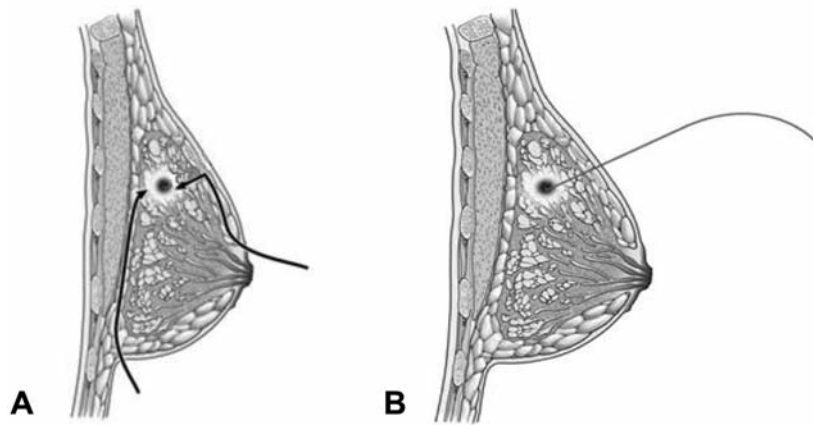


Figure 1. Different access of the wire-guided localization technique: conventional technique (A) and 'optimized' technique (B).

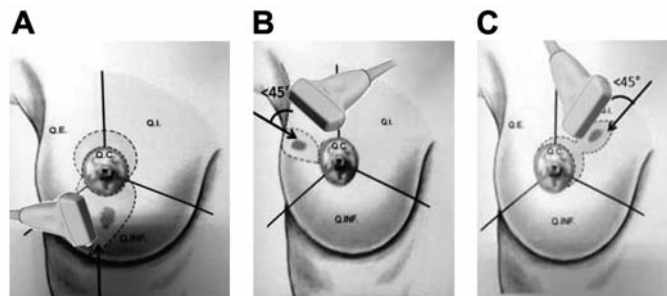


Figure 2. Access for 'optimized' wire-guided localization technique according to the breast quadrant with non-palpable tumor. A: Limit of the lower quadrants. B: Upper-external quadrant. C: Medial quadrants. Legend: Q.I., medial quadrant; Q.E., upper-external quadrant; Q.Inf., lower quadrants.

Table I. Localization of the breast lesions in this study (total patients, N=40).

Location	Conventional technique N=20	Optimized technique N=20	p-Value
Upper external quadrant	10	8	0.75
Lower external quadrant	1	1	0.46
Lower internal quadrant	1	3	0.59
Upper internal quadrant	5	6	>0.99
Retro-areolar area	3	2	>0.99

during the surgical procedure. With the optimized technique, we did not have any accidental intra-operative cutting of the wire and the surgical margins were adequate without the indication for performing a re-excision ($p=0.047$ and $p=0.02$, respectively).

Even if the conventional WGL technique provided an execution time significantly shorter than the optimized WGL technique, we found a statistically significant difference

between the two procedures in the incidence of surgical complications, with better outcomes from the optimized procedure, allowing for a shorter operative time.

Discussion

The diagnosis of primary breast cancer is eventually being achieved at earlier stages. Screening programs and the

greater awareness of the female population have increased the rate of breast cancer diagnosis at a pre-clinical non-palpable stage (4, 17). BCS is the suitable surgical approach in non-palpable breast cancer, which requires for preoperative localization, in order to ensure complete excision of the tumor (8, 22, 23). This has led to development of different localization techniques (23, 24). The WGL procedure described by Frank *et al.* (25) was one of the first to be used and is still one of the techniques most frequently used. This procedure is simple, it can be performed under ultrasound, stereotactic or MRI guidance, and it does not involve administration of radioactive tracers (24, 25).

However, complications of the WGL procedure are possible, making it difficult to identify the lesion intraoperatively. Frequently, the problem is the access point for the wire guide. It is often far from the ideal site for surgical incision, forcing the surgeon to tunnel under the skin in order to arrive at the lesion. This can subsequently cause dislocation or involuntary sectioning of the wire. Moreover, it causes an increase of surgical time.

We tried to solve this problem through using an optimized WGL technique, designed in collaboration with surgeons. This takes into account both the site and the morphology of the surgical incision, allowing lower rates of complications and better esthetic results.

In our experience with the optimized technique, dislocation of the guide wire occurred only in two cases, but even then it did not cause problems because the lesion was located immediately above the end of the wire and the glandular surgical excision completely removed the lesion. It was not necessary to enlarge the surgical excision. No other complications were observed for this group of patients.

Among the techniques of alternative localization of breast lesions, it is necessary to consider the ROLL technique, described for the first time in 1998 by Luini *et al.* (16). It involves the preoperative injection of colloidal particles of human albumin labeled with radioactive technetium within the lesion under ultrasound or mammography guidance. Sentinel node and occult lesion localization technique (SNOLL) is the evolution of the ROLL technique. It is the simultaneous location of the occult lesion and the sentinel lymph node related to it using a single dose of intra- and peri-lesional nanocolloidal radiotracer. It allows both accurate localization of non-palpable breast lesions and the identification of the sentinel lymph node (17, 26).

Randomized trials have compared ROLL with WGL, concluding that ROLL is easier to implement by radiologists and surgeons, it allows improved esthetic results and is less painful for patients (27-31). A recent systematic review by Sajid *et al.* (10), that compared ROLL to WGL, documented no differences between the two techniques in terms of localization rate, complication rate, reoperation rate, volume

and weight of the excised breast lesion, but a lower risk of positive margins, shorter localization time, and shorter surgical excision time for ROLL compared to WGL. Nevertheless, the authors concluded that the obtained results should be considered cautiously for different reasons, such as significant clinical and methodological diversity among the reported trials, lack of information about the medical (surgeons and radiologists) level of experience and about the localization of the lesion in relation to breast size and whether this was controlled for in the sample size (10).

In addition, we have to consider that centers with availability of ROLL and SNOLL techniques are few, therefore at present, WGL is the most widely used technique (10, 31). For this reason, we tried to optimize the WGL technique, in collaboration with surgeons, in order to overcome its disadvantages and strengthen the current evidence.

A number of limitations of our study remain, in particular the quite small sample size of our cohort and the non-repeatability as the optimized technique is not standardized.

Conclusion

Making small changes to the conventional WGL technique has allowed complications already described several years ago by Frank *et al.*, such as wire dislocation, accidental wire section, and inadequate margin resection to be overcome (25). The use of ultrasound or mammography guidance for WGL, unlike the modern techniques SNOLL and ROLL, that require higher costs and have longer lead times, allowed us to perform the localization procedure immediately before the surgery, reducing hospitalization time and healthcare costs.

The optimized WGL technique, in collaboration with surgeons, provides greater surgical safety, a reduction in medical care requirement and greater satisfaction of patients according to the criteria of radical surgery in current guidelines.

Disclosure

The Authors have stated that they have no conflicts of interest.

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