Multiple Iodine-125 radioactive seed localizations: single institution experience.

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Learning objectives

1. Illustrate the typical appearance of radioactive seeds and discuss radioactive seed localization (RSL) technique using both ultrasound and digital mammographic guidance, including accuracy of localization using each technique.

2. Provide indications for multiple seed localization.

3. Discuss the surgical outcome of multiple RSL with regards to success rates for localization as well as evaluation of positive or close surgical margins and need for re-excision.

4. Demonstrate the advantages and disadvantages of RSL compared to wire localization (WL).

Background

Wire localization is the standard technique to localize nonpalpable breast lesions.

There are many disadvantages of wire localization, including the need to localize lesions on the day of surgery, patient discomfort and potential displacement of wire during transfer, inability to visualize the exact location of targeted lesion in the breast by the surgeon which may result in extensive dissection, as well as high reported rates of positive microscopic margins.

Iodine-125 (I-125) radioactive seed localization (RSL) has been shown to be a safe procedure and is a comparable technique to wire localization (WL) with no difference in surgical outcomes.

There is little information in the current literature about multiple RSL for bracketing larger lesions or to guide excision of multiple lesions.

Findings and procedure details
OBJECTIVE 1: Discuss the typical appearance of radioactive seeds.

The appearance of titanium radioactive seeds is readily distinguished with the typical radiolucency surrounding a dense central bar (Fig. 1 on page 6, pink arrow), which is different from biopsy marker clips or surgical clips (Fig. 1 on page 6 and Fig. 2 on page 6).

OBJECTIVE 2: Provide indications for multiple seed placement.

- Localization of multicentric or multifocal malignant breast lesions or lesions with atypia (Fig. 14; Fig. 17 on page 19 and Fig. 18 on page 20).
- Bracketing of a large area of segmentally distributed calcifications or extensive invasive disease (Fig. 13; Fig. 15; and Fig. 20 on page 22).

Our study included 86 patients with 175 lesions that underwent multiple RSL in the same breast: 29.1% of localizations were performed under ultrasound-guidance, 61.6% were performed under digital mammographic guidance, and 9.3% were performed using a combination of ultrasound and mammographic guidance.

Of the 175 lesions, 79 (45.1%) masses and 96 (54.9%) calcifications or biopsy clips were localized. Biopsy clips were localized under mammographic guidance when no residual calcifications were seen following percutaneous core needle biopsy or no residual sonographic mass was seen following core needle biopsy or neoadjuvant chemotherapy.

Multiple lesions in the same breast were localized in the vast majority of patients (81.4%). Seed bracketing was performed in 16 of 86 patients (18.6%), primarily to localize calcifications (87.5%) (Fig. 20 on page 22). In the vast majority of patients with multifocal or multicentric disease, 2 lesions were localized; 3 lesions were localized in 6 of 86 patients (7.0%).

Since Iodine-125 RSL can be performed weeks to months prior to definitive surgery, other institutions have described placement of radioactive seeds at time of biopsy or prior to initiation of neoadjuvant chemotherapy. All 86 patients included in our study underwent localization shortly before time of surgery, usually within a day or two (0-3 days).

OBJECTIVE 3: Discuss the technique of radioactive seed localization (RSL) using ultrasound guidance.

Radioactive seed localization of lesions using ultrasound guidance is very similar to placing a biopsy marker clip in the targeted lesion (Fig. 3 on page 7). The
introducer needle is well seen sonographically and the seed (Fig. 4 on page 8 and Fig. 5 on page 9, pink arrow) is easily visualized as a linear, echogenic structure immediately adjacent (superior) to the marker clip (Fig. 4 on page 8). Post localization mammogram (Fig. 6 on page 10) demonstrates two seeds in ideal location, immediately adjacent to the respective marker clips.

Once the seed is deployed, the distance from the seed to the overlying skin is measured to estimate depth in preparation for surgical excision (Fig. 17).

**OBJECTIVE 4: Discuss the technique of RSL using mammographic guidance.**

While radioactive seed localization using digital mammographic guidance is similar to wire localization, RSL is more convenient for the patient and avoids the migration, displacement, and kinking/fracture not uncommonly seen with wire localization.

As with wire localization, the simplest and shortest distance approach is chosen; lateral approach is illustrated in Fig. 7 on page 11 and the grid is used to aid in needle placement and advancement. The introducer needle is advanced to a greater depth than the anticipated location of the target. The localization is switched to the orthogonal view, the needle is pulled back the appropriate distance to the level of the target, and the seed is deployed (Fig. 8 on page 12). Additional example of multiple RSL of multifocal malignancy localized under digital mammographic guidance (Fig. 9 on page 13) demonstrates ideal placement of both seeds, which are located immediately adjacent to their respective biopsy clips.

**OBJECTIVE 5: Discuss the accuracy of RSL using ultrasound versus mammographic guidance.**

Our study showed more accurate localization using ultrasound guidance as the procedure is performed using real-time ultrasound where the targeted lesion is well visualized and fine adjustments can easily be made.

In our experience, RSL failure was observed only with mammographic guidance in 3 of 86 patients (3.5%) due to suboptimal positioning of the seed in relation to the target. Placement of an additional seed was required in 2 of the 3 patients (Fig. 19 on page 21), and subsequent guide wire localization was required in the third patient (Figures 10-12). No cases of ultrasound-guided RSL failed localization.
Malpositioned seed localization under mammographic guidance (Figures 10-12). Localization is performed from a craniocaudal approach; initial CC view demonstrates ideal placement of the introducer needle (Fig. 10 on page 14B). The breast is compressed in the orthogonal (lateral) view, the introducer needle is pulled back to the level of the targeted lesion, and the clip is deployed (Fig. 11 on page 15). Post-localization mammogram (Fig. 11 on page 15D) demonstrates the malpositioned seed almost 2 cm lateral and slightly posterior to the intended target. The patient returned the following day for wire localization of the lesion (Fig. 12 on page 16).

**OBJECTIVE 6: Discuss the surgical outcome of multiple RSL with regards to success rates for localization as well as evaluation of positive or close surgical margins and need for re-excision.**

Accurate preoperative localization of non-palpable lesions is essential to achieve clear surgical margins. Analysis of our data reports:

- Success rate of 99% for multiple RSL of multiple lesions or bracketing of extensive disease; only one patient returned for wire localization after suboptimal seed placement.
- 98% rate of seed retrieval within the first specimen; no seed loss was reported (Fig. 15 and Fig. 16).
- Lower rate of intraoperative re-excision of margins at time of surgery when compared to wire localization. Due to intraoperative frozen section evaluation of all breast specimens at our institution, no patient returned for a second re-operation.

**OBJECTIVE 7: Demonstrate the advantages and disadvantages of RSL compared to wire localization (WL).**

**Advantages:**

- No post-localization migration, displacement, or kinking/fracture, which is not uncommonly seen with wire localization.
- Flexibility in surgical date and scheduling due to the long half-life of Iodine-125 (~60 days); surgery can be performed weeks to months after localization.
- Lower rates of positive or close microscopic margins as compared to wire localization, for institutions that do not utilize intraoperative frozen sections to determine margin status.
- More accurate placement of the surgical incision to avoid unnecessary scars as the skin entry site of the wire is typically remote from the targeted lesion and wire tip.
Disadvantages:

- Inability to reposition the seed following deployment.
- Higher cost of radioactive seeds than guide wires.
- Strict regulatory guidelines for handling of radioactive substances.

Images for this section:

Fig. 1: Typical appearance of a radioactive seed, here in a lumpectomy specimen, demonstrates the radiolucency surrounding a dense central bar (pink arrow).
Fig. 2: The radioactive seed (left side of image) is readily distinguished from a surgical clip (right) due to the typical appearance of radiolucency surrounding a dense central bar.
**Fig. 3:** Ultrasound-guided seed placement for a biopsy-proven high grade invasive ductal cancer. The introducer needle, which contains the radioactive seed, is well seen under ultrasound.
**Fig. 4:** The deployed radioactive seed (pink arrow) is seen as a linear echogenic structure similar to the sonographic appearance of the biopsy marker clip, which is immediately adjacent to the seed.
**Fig. 5:** Ultrasound-guided seed localization of an additional biopsy-proven cancer in the same patient. The introducer needle containing the seed (pink arrow) is well visualized immediately adjacent to the biopsy clip (white arrow).
**Fig. 6:** Post localization mammogram demonstrates both radioactive seeds immediately adjacent to the respective biopsy marker clips.
Fig. 7: RSL using digital mammographic guidance and a lateral approach to localize a biopsy-proven malignancy, which is marked with a bar-shaped biopsy clip. The grid aids in needle placement and advancement; the needle is advanced to a greater depth than the anticipated target.
Fig. 8: RSL under digital mammographic guidance in the same patient after switching to the orthogonal view (CC view in this example). The introducer needle is seen 2 cm past the target (A), needle is pulled back 2 cm to the level of the target (B), and the seed is deployed (C) landing immediately adjacent to the targeted mass and clip.
**Fig. 9:** 82-year-old female with multifocal IDC localized under digital mammographic guidance. Both radioactive seeds are located immediately adjacent to their respective biopsy clips.
Fig. 10: RSL using digital mammographic guidance from a craniocaudal approach demonstrates the biopsy-proven DCIS (A) and ideal placement of the introducer needle (B).
Fig. 11: In the same patient, the breast is compressed in the orthogonal view (lateral view), the introducer needle is pulled back to the level of the targeted lesion (A and B), and the clip is deployed (B and C). Post-localization mammogram (D) demonstrates the malpositioned seed (pink, solid line) almost 2 cm lateral and slightly posterior to the intended target (yellow, dashed line). A second well-positioned seed localizes an additional invasive cancer in the anterior breast.

Fig. 12: The patient returned the following day for wire localization of the invasive cancer in the lateral breast. The thick portion of the wire is seen just anterior to the targeted lesion; a 14 cm segment of the wire lies outside the breast.
Fig. 13: 70-year-old female with DCIS, marked with an '0' clip. Two seed localization was performed using digital mammographic guidance to bracket the 3.8 cm area of DCIS (C); residual calcifications could not be visualized due to a small hematoma at the biopsy site (A and B). Lumpectomy specimen contains both seeds and marker clip (D).
**Fig. 14:** 68-year-old female with multifocal malignancy in the left breast. A 3 seed localization was performed under digital mammographic guidance. The ribbon clip marks an invasive mammary carcinoma while the '0' clip and coil clip each mark an additional site of DCIS. Initial lumpectomy specimen (C) did not contain the third lesion, clip, and seed so additional tissue was excised (D), which removed all intended targets.
**Fig. 15:** 57-year-old female with biopsy-proven DCIS. The 'S' marker clip is located along the anterior margin of the suspicious calcifications, which extend over a 4.5cm area in a segmental distribution in the lateral left breast. Under mammographic guidance, two seeds were deployed to bracket the large area of suspicious calcifications.

**Fig. 16:** Lumpectomy specimen from patient in Figure 15 demonstrates successful retrieval of the targeted calcifications, biopsy clip, and both seeds upon initial excision. Intraoperative margins were negative.
Fig. 17: 72-year-old female with multicentric invasive cancer in the right breast. Under ultrasound-guidance, a seed is deployed into the center of the hypoechoic mass and the distance of the clip to the overlying skin is measured to estimate depth.
Fig. 18: Post localization mammogram in the same patient as Figure 17 demonstrates ideal localization of multicentric invasive cancer; both seeds are located immediately adjacent to the respective biopsy clip.
**Fig. 19:** 60-year old female with invasive mammary cancer, marked with a coil clip. Post localization mammogram demonstrates the radioactive seed (pink arrow) is displaced approximately 2 cm inferior to the targeted coil clip (pink circle) (B). Placement of an additional seed (yellow arrow) was required to accurately localize the malignancy (C and D).

**Fig. 20:** 61-year-old female with biopsy-proven DCIS (A; dotted line), marked with a biopsy clip and associated small hematoma. Two seeds were deployed to bracket the residual calcifications which extend over a 2.5 cm area in the transverse plane, as seen
on the magnification CC view (A). The marker clip is seen between the two seeds (B) and is slightly displaced superiorly from the residual calcifications (C).
Conclusion

Multiple radioactive seed localization is a safe alternative to multiple wire localizations for larger lesions (bracketing) or localization of multiple lesions in the same breast.

Personal information

References


