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Implementation of Preoperative Magnetic Seed Localization for Breast and Axillary Lesions: An Alternative to Wires and Radioactive Seeds

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A B S T R A C T

Since the 1970s, preoperative localizations for breast lesions and axillary lymph nodes have been achieved by the placement of a wire through the area of concern. Other techniques have recently been developed. The focus of this article is on a novel preoperative technique, the magnetic seed localization. A magnetic seed is placed into the lesion or lymph node under mammographic or sonographic guidance. The advantages and disadvantages are discussed in the article.

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Introduction

Breast cancer remains the most commonly diagnosed cancer in American women (Stewart & Wild, 2014). Implementation of robust mammographic screening programs has resulted in more cancers being diagnosed by imaging. Currently, 25% to 35% of breast cancers are nonpalpable at the time of diagnosis (Patel et al., 2017), meaning their location within the breast can only be known by imaging techniques. Therefore, at the time of surgical excision, the surgeon needs a method to localize the lesion within the breast for removal. This is traditionally done with wire localization (WL), a technique by which the radiologist advances a needle into the target lesion under direct image guidance. When the needle is positioned satisfactorily through the lesion, a thin flexible hook-shaped wire is deployed through the needle to sit securely within the lesion. The needle is removed, and the wire is taped to the patient's skin. In the operating room (OR), the surgeon will dissect into the breast tissues until the lesion is found along the wire. This method has changed little since it was first developed in the 1970s (Hall et al., 2013), and many of its inherent pitfalls and limitations remain even as it is used today.

Recently, we have seen the development and increasing use of several new techniques that overcome some of the limitations of traditional WL (Hayes, 2017; Jeffries et al., 2017). Radioactive seed localization uses a small titanium pellet containing radioactive iodine-123 (Goudreau et al., 2015; Sharek et al., 2015). It can be placed directly into the target lesion using a stylet and plunger apparatus under image guidance. Reflector-guided localization (Savi Scout®; Cianna Medical, Inc., Aliso Viejo, CA) is another option (Mango et al., 2016; 2017; Patel et al., 2017). This method uses a device that is placed similar to the radioactive seed but instead emits a radiofrequency signal when engaged. Both these devices can then be localized in the OR by their respective sensoring equipment. By moving a probe over the skin surface, the surgeon receives feedback as the sensor approaches the location of its target device within the breast. The surgeon dissects through the tissues at that location until the device and the associated lesion are identified.

Magnetic seed (Magseed®; Endomagnetics, Inc., Cambridge, UK) localization (MSL) is the most novel technique for image-guided localization of nonpalpable breast lesions, and several centers are using this technology. The Magseed® is a 1 × 5 mm implantable device (Figure 1), which can be placed into or near a target lesion under direct mammographic or sonographic guidance. The Magseed® contains iron particles. When used with the Sentimag® surgical guidance probe (Endomagnetics Inc., Cambridge, UK) (Figure 2), the iron particles generate a transient magnetic field. This allows the location of the Magseed® to be detected by the probe. We have placed more than 221 Magseeds® at our institution. This article will discuss the advantages, disadvantages, and implementation of Magseeds® within a radiology program.

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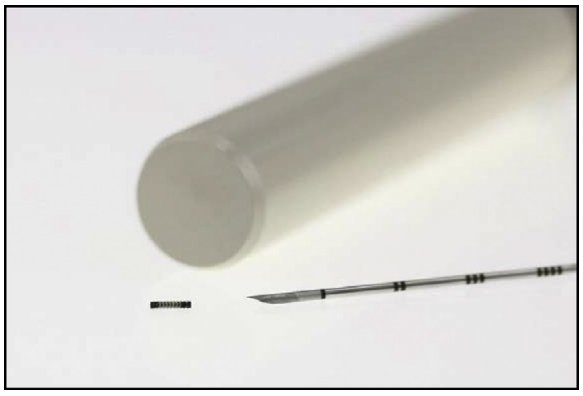

Figure 1. 1 × 5 mm Magseed® deployed through an 18-gauge stylet. The transient magnetic field produced by the Magseed® is detected by the Sentimag® probe. Courtesy of Endomagnetics, Inc., with permission.

Advantages

Most notably, MSL decouples the date of localization from the date of surgery, allowing for greater flexibility with patient and OR scheduling when compared with WL. The patient no longer has to arrive early on the day of surgery, check into a different department, and have an additional procedure the same day. Rather, the Magseed® can be placed any time before the date of surgery (Endomagnetics, Inc., n.d.). At our institution, we have been placing Magseeds® at the time of the preoperative visit for many of our patients, thereby reducing the number of additional visits needed. This method also reduces OR delays resulting from delays in the localization process on the day of surgery.

Like radioactive seeds and Savi Scout® (Cianna Medical, Inc., Aliso Viejo, CA) devices, the Magseed® remains entirely within the patient from placement to excision. This greatly reduces the risk of breakage and migration compared with traditional wires (Sharek et al., 2015). In addition, this has the benefit of allowing the radiologist greater flexibility when selecting the approach for device placement. Because traditional wires protrude from the breast at the time of excision, the surgical approach often follows the path of the wire. As a result, some surgeons prefer to discuss optimal approach for wire positioning with the radiologist before placement. Magseeds® and other fully implantable devices are deployed with the approach best for the patient and radiologist.

Unlike the radioactive seed, the Magseed® has no radioactive components, eliminating the need for radiation safety precautions (Goudreau et al., 2015). This is often cited as one of the largest barriers to using the radioactive seed. Also, Magseeds® can be surgically removed at a location different to where they were placed, allowing the patient even greater flexibility when scheduling appointments. In addition, because of the inherent design and lack of active components, the Magseed® is essentially indestructible and poses no danger to the patient, radiologist, or pathology staff (Gilcrease et al., 2016; Jeffries et al., 2017; Li et al., 2017).

Disadvantages

The largest barrier to implementing a Magseed® program is often cited as the equipment cost of purchasing the Sentimag® surgical guidance probe as well as the individual Magseed® units. However, the increased efficiency of the Magseed® program must be considered, with the potential benefit of decreased OR delays and ease of patient and departmental scheduling (Zhang et al., 2017).

Because of the nature of the magnetic interaction between the Magseed® and sensor, *nonmagnetic instruments and equipment* must be used in the OR when the sensor equipment is used. Stainless steel and other metal equipment interferes with the localization signal. Titanium and polymer equipment serve as an alternative. These limitations must be taken into account when considering the establishment of a new Magseed® program at an

Figure 2. Sentimag® surgical guidance probe. Courtesy of Endomagnetics, Inc., with permission.

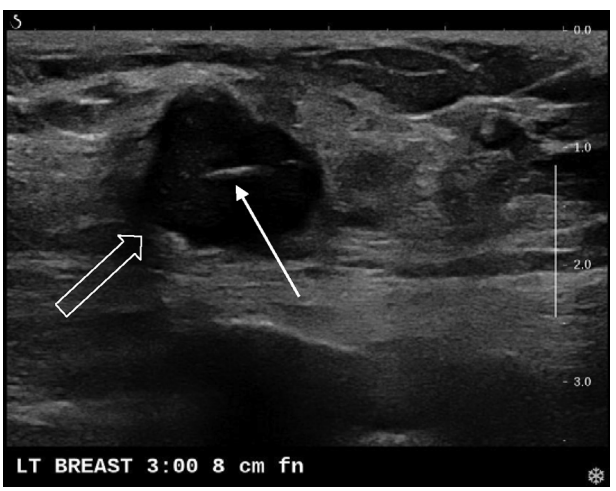

Figure 3. Ultrasound image demonstrating a hypoechoic mass (*open arrow*) containing a Magseed® (*thin arrow*) after deployment under direct ultrasound guidance.

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