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Comparative Evaluation of Iodine-125 Radioactive Seed Localization and Wire Localization for Resection of Breast Lesions

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Abstract

Purpose: Radioactive seed localization (RSL) uses a titanium seed labeled with iodine-125 energy for surgery of nonpalpable breast lesions. RSL facilitates radiology−surgery scheduling and allows for improved oncoplasty compared with wire localization (WL). The purpose of this work was to compare the 2 techniques.
Methods: We performed a retrospective study of all breast lesions operated with RSL between February 2013 and March 2015 at our university institution, and compared with an equivalent number of surgeries performed with a single WL. Imaging and pathology reports were reviewed for information on guidance mode, accuracy of targeting, nature of excised lesion, size and volume of surgical specimen, status of margins, and reinterventions.
Results: A total of 254 lesions (247 women) were excised with RSL and compared with 257 lesions (244 women) whose surgery was guided by WL. Both groups were comparable in lesion pathology, guidance mode for RSL or WL positioning, and accuracy of targeting (98% correct). Mean delay between biopsy and surgery was 84 days for RSL versus 103 after WL ($P = .04$). No differences were noted after RSL or WL for surgical specimen mean weight, largest diameter, and volume excised. For malignancies, the rate of positive margins was comparable (2.8%-3%), with 5 of 10 women in the RSL group who underwent a second surgery displaying residual malignancy compared with 3 of 9 women in the WL group.
Conclusions: RSL is safe and accurate, and has comparable surgical endpoints to WL. Because RSL offers flexible scheduling and facilitated oncoplasty, RSL may replace WL for resection of nonpalpable single breast lesions.

Résumé

Objectif : Le repérage au grain radioactif consiste à utiliser un grain de titane marqué à l'iode 125 dans le cadre d'interventions chirurgicales visant des lésions mammaires non palpables. Le repérage au grain radioactif facilite la coordination des rendez-vous en radiologie et en chirurgie. Il offre aussi de meilleures possibilités d'oncoplastie que le repérage à l'hameçon. Les présents travaux avaient pour objectif de comparer les deux techniques.
Méthodes : Nous avons effectué une analyse rétrospective de toutes les lésions mammaires ayant fait l'objet d'une intervention chirurgicale avec repérage au grain radioactif entre février 2013 et mars 2015 au sein de notre établissement universitaire. Nous les avons ensuite comparées à un nombre égal de lésions ayant fait l'objet d'une intervention chirurgicale avec repérage à un seul hameçon. Les rapports d'imagerie et de pathologie ont été examinés afin de recueillir des renseignements sur le mode de guidage, la précision du repérage, la nature des lésions excisées, la taille et le volume des prélèvements chirurgicaux, l'état des marges chirurgicales et les reprises chirurgicales.
Résultats : Au total, 254 lésions (247 femmes) excisées à l'aide d'un repérage au grain radioactif ont été comparées à 257 lésions (244 femmes) excisées à l'aide d'un repérage à l'hameçon. Les deux groupes affichaient des caractéristiques semblables sur le plan de l'analyse pathologique des lésions, du mode de guidage pour le positionnement du grain radioactif ou de l'hameçon, et de la précision du repérage (exactitude à 98 %). Le délai moyen entre la biopsie et l'intervention chirurgicale se chiffrait à 84 jours pour le repérage au grain

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radioactif, contre 103 jours après le repérage à l'hameçon ($P = 0,04$). Aucune différence n'a été relevée après repérage au grain radioactif ou à l'hameçon au chapitre du poids moyen, du diamètre le plus grand et du volume excisé des prélèvements chirurgicaux. En ce qui concerne les lésions malignes, les taux de marges chirurgicales positives étaient comparables (de 2,8 à 3 %). Cinq des 10 femmes du groupe de repérage au grain radioactif ayant subi une deuxième intervention ont affiché des lésions malignes résiduelles, contre 3 chez les 9 femmes du groupe de repérage à l'hameçon.

Conclusions : Le repérage au grain radioactif est sécuritaire et précis, et ses indicateurs de résultats chirurgicaux sont comparables à ceux du repérage à l'hameçon. Le repérage au grain radioactif pourrait remplacer le repérage à l'hameçon pour la résection de lésions non palpables à un sein puisqu'il offre plus de souplesse pour la planification des rendez-vous et facilite l'oncoplastie.

Key Words: Conservative breast surgery; Radioactive seed localization; Wire localization

Image-guided wire localization (WL) immediately before surgical resection is the standard of care for preoperative localization of nonpalpable breast lesions [1], and remains so in Canada in 2016. Although effective, this procedure has several drawbacks: because the wire has an external component, incidental displacement may occur after positioning at any stage prior to or during surgery [2,3]. In addition, kinking, fracturing, or transection of the wire has been reported to occur in up to 3% of patients [4−7]. Most importantly, because it is not possible to determine precisely the location of the wire tip transcutaneously, before incising the skin and approaching the lesion, the surgeon must follow the wire to the lesion, sometimes with an entry point that does not represent the best surgical approach and may lead to unnecessary tissue loss or reoperation [8,9]. Finally, because wire placement is usually done the same day as the surgery, scheduling conflicts may arise between the imaging department and the operating room, adding stress and potentially introducing significant delays to the operating room schedule [10].

Radioactive seed localization (RSL) was first proposed as an alternative preoperative localization method in 1999 by Gray et al (presented at the 85th congress of the American College of Surgeons, San Francisco, CA) who had developed, at the H. Lee Moffitt Center in Florida, a method for breast lesion localization that used a small titanium seed labeled with light radioactive iodine-125 (^{125}I) energy [11,12]. This seed, originally used by radiation oncologists for prostate cancer brachytherapy, emits a radiation source of 27 keV and has a half-life of 60 days. It also has the advantage of being mammographically visible. Strict conditions for seed handling are essential and require thorough tracking of every seed's path, from delivery to the hospital to return to the radioprotection officer responsible for the seed program, who ensures continuous tracking as the seed transits to the radiology department, into the breast for surgery, in the operating suite for surgical removal, until confirmation of reception in the pathology laboratory along with the breast specimen [13−15]. At our institution, the ^{125}I radioactive seed used for breast surgery is delivered for breast implantation at a maximum of 150 μCi of radioactivity.

To allow placement into the breast, the ^{125}I seed is first inserted into a hollow needle and then placed at the centre of a breast lesion targeted for surgical excision, using either sonographic or stereotactic guidance. After implantation, before the patient leaves the radiology department, successful seed implantation is confirmed with a gamma probe and its exact position within the breast, and in relation to the lesion of interest, is verified by obtaining a postprocedure 2-view mammography. The half-life of 60 days of ^{125}I allows for flexibility of seed positioning, with consequent benefits in terms of operating room schedule, because the seed can be placed in the breast several days prior to surgery [16−18]. At our institution, the accepted maximum time interval between seed positioning within the breast and surgery is 5 days.

RSL generally does not interfere with sentinel node mapping, performed with technetium-99 (^{99}Tc) sulfur colloid: a gamma probe can differentiate the 2 isotopes, ^{99}Tc and ^{125}I, allowing for concomitant sentinel node localization and RSL [12,15,19]. To facilitate separation of the 2 isotopes at the time of surgery, a periareolar injection for ^{99}Tc sulfur colloid is necessary rather than a peritumoural approach, to allow for maximum physical separation from the ^{125}I seed that is placed centrally within the lesion of interest. Concomitant sentinel node technique is successful in 97%-100% of cases [20−22].

Studies have demonstrated promising results for RSL in terms of surgical endpoints [3,19,23,24]. Studies have reported reduced positive margin rates (by 35%-59%) with RSL [11,20,21,25−27], with a concomitant statistically significant increase in negative margin rates (from 73%-97%) with RSL [19−22,26]. Ahmed and Douek [23], in their meta-analysis, calculated an improved risk ratio for margins of 0.51 with RSL compared with WL. Pouw et al [24] reported improved reoperation rates, from 56% with WL to 42% with RSL, and other authors have made similar observations [21,28,29]. Other authors did not observe these statistical differences between RSL and WL in terms of reintervention rates [3,17,18,30,31].

Again, some disparities exist regarding a possible improvement in the volume of tissue excised with RSL compared with WL, with some reporting no significant difference [3,11,18,23,29,30], whereas others [16] report smaller excised volumes with RSL. Finally, there is general agreement that, with RSL, marked improvements in operation times can be achieved [3,18], with reports of improved time allocation, scheduling, and biopsy wait times [30,32].