Effect of Wire Localization Performer in Local Excision Biopsy for Mammographic Microcalcifications

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Purpose: The aim of the study was to investigate whether execution of wire localization and excision by the same operator can improve accuracy and excision time in local excision biopsy of mammographic microcalcifications. Methods: Medical records of patients who underwent diagnostic excision biopsy for mammographic microcalcification between May 2011 and December 2014 were reviewed. Forty-three localized excision biopsies were performed in 41 patients during this period. We compared operation time, specimen size for the target cluster size, and re-excision rate in patients in whom wire localization and excision were performed by the same operator, with those in whom wire localization and excision were performed by a radiologist and operator, respectively. Results: The median operation time of the group that underwent wire localization performed by the operator was 64 minutes, compared to 79 minutes in the group that underwent wire localization performed by a radiologist. However, this was not a statistically significant difference (p = 0.111). The median detection time (the time between start of incision and verification for the final specimen mammography) was 42 minutes in the former group, which was significantly shorter in univariate (p = 0.044) and multivariate (p = 0.018) analyses than the 59 minutes for the latter group. There was no significant difference between the two groups in specimen size for the target cluster size, or in re-excision rates. Conclusion: Execution of wire localization by the operator, instead of a radiologist, may contribute to shorter operation times, without increasing extent of resection or re-excision rate in local excision biopsy for mammographic microcalcification.

Key Words: Image-guided biopsy, Interventional radiography, Mammography

INTRODUCTION

Mammographic microcalcification is a typical abnormal finding in cases of breast cancer, detected by mammography. Depending on the nature of the finding, a biopsy may be required for confirmation of pathology. In particular, for some intraductal breast carcinomas, suspicious mammographic microcalcification may be the only abnormal finding present, without any palpable lesions or corresponding sonographic abnormalities [1-3].

In these cases, traditionally the lesion would be localized and excised by mammography-guided wire insertion. Recently, with advances in vacuum-assisted biopsy devices, different stereotactic biopsy methods are also being used to assess mammographic microcalcifications.

Under Korea’s National Insurance themes, the aforementioned stereotactic biopsy methods cost two to three times more than wire localization excision. For thin women with small breasts, using or accessing stereotactic biopsy devices can be challenging [4,5]. Therefore, wire localization excision biopsy may be preferred for confirmation of pathology in case of indeterminate mammographic microcalcifications.

A radiologist usually performs wire localization guided by mammography, and a surgeon then determines the target area of microcalcification by looking at a selection of mammographic images of wire localization procedure. However, finding a target microcalcification and performing an accurate excision can be challenging after reviewing only a few images of wire localization performed by others. An additional resection may be required, or more than one excision may be necessary because the target microcalcification is not included in the mammography images. In particular, if wire localization is not performed precisely, a surgeon faces the even more challenging task of establishing the exact location of the microcalcification [6].

In our institution, there are instances when a radiologist performs the wire localization of mammographic microcalcification, and a surgeon subsequently performs the operation. Alternatively, one operator
may perform both the wire localization and the operation. Therefore, we investigated the effects of a single operator performing both wire localization and surgery for microcalcifications, on operation duration and accuracy.

**METHODS**

Patients who underwent diagnostic excision biopsies between May 2011 and December 2014, due to indeterminate microcalcifications reported by mammography, were included in the study. Forty-three localized excision biopsies were conducted in 41 patients. Stereotactic biopsies that used vacuum-assisted systems were excluded. All patients were required to provide written informed consent. The study was approved by an independent review board at the Seoul Medical Center of Korea and carried out in accordance with local regulations (IRB number: 2015-037).

Mammography was performed using a Selena device (Hologic, Bedford, USA), and an open localization paddle was selected for compression during wire localization. Accura™ BLN (Argon, Athens, USA) was used for localizing wire, and one localizing wire was used per cluster of microcalcification.

Wire localization was performed by three radiologists and two surgeons. In cases where a surgeon conducted wire localization, the same surgeon also performed the surgical excision.

Medical information collected from patients included age, gender, body mass index (BMI), Breast Imaging Reporting and Data System (BI-RADS) category of preoperative mammographic images, wire localization performers, operation time, estimated specimen volume (length × width × thickness, cm³), whether or not additional resection was required, and postoperative pathological diagnosis.

Review of mammography films confirmed maximum diameter of microcalcification areas and estimated breast volume. The formula recommended by Kalbhen et al. [7] was used to estimate breast volume (V [cm³] = 0.785 × H [cm] × W [cm] × C [cm]). This formula represents the breast volume as a half elliptical cylinder in the craniocaudal projection where H is the posterior-to-anterior height measured perpendicular from posterior film edge to the most anterior portion of the breast (usually the nipple areola complex), W is the medial-to-lateral width measured along the posterior film edge, and C is the compression thickness of the breast in the craniocaudal view.

Nonparametric statistical analyses (Mann-Whitney U-test and chi-square test with Fisher exact test) were used to compare the radiologist-conducted wire localization group data and operator-conducted group data. In addition, multivariate analysis using a linear regression model was conducted to confirm statistical significances. A two-sided p-value < 0.05 was considered statistically significant. All analyses were performed using SPSS software version 18.0 (SPSS Inc., Chicago, USA).

**RESULTS**

**Basic patient information and operation information**

Out of 41 patients who underwent diagnostic localized excision biopsy for mammographic microcalcification, two patients had localized excisions performed for microcalcifications in both breasts, making the total count of localized excisions 43. A further two patients underwent localized excision on one breast and breast cancer operation on the contralateral breast.

Mean age of patients was mean age 51 (31–79, SD 10.851) and mean BMI 22.7 kg/m² (16.7–31.1, SD 3.210). Mean estimated breast volume (affected side) was mean breast volume 379 mL (101–1,035, SD 214.558), median target microcalcification cluster size was median target cluster size 2.1 cm (0.2–5.9, SD 1.4), and median specimen volume 29 cm³ (2–98, SD 25.589).

Radiologists performed mammography-guided localizing wire insertion on 19 patients and operators conducted the same procedure on 22 patients. Two breast surgeons conducted the surgical excisions and 28 out of 43 were conducted under general anesthesia and 15 under local anesthesia.

Preoperative mammographic BI-RADS reported two cases of BI-RADS C3, 28 cases of C4a, 10 cases of C4b, and three cases of C4c. Postoperative pathology results reported 14 cases of fibrocystic changes, 11 cases of ductal carcinoma in situ, eight cases of atypical ductal hyperplasia, three cases of intraductal papilloma and one case of invasive ductal carcinoma, and six cases with other conditions.

Excised specimens were examined for the presence or absence of microcalcifications using postoperative specimen mammography. As a result, additional resection was performed in 12 cases (27.9%).

With the exception of two patients, whose operation duration
could not be measured accurately due to localized excision on both breasts, and another two patients who underwent localized excision and breast cancer surgery at the same time, the median operation duration was 70 minutes. After checking if target microcalcifications were well excised with specimen mammography, due to duration differences caused by excision depths, need for parenchymal reconstruction, and suturing methods, a new variable “detection time” or duration from time of incision to when the specimen’s suitability was confirmed by final specimen mammography, was calculated. The median detection time was 50 minutes.

The median specimen volume was 29 cm³, but taking into consideration that a larger microcalcification area means a larger excision area, and a larger specimen volume accordingly, specimen volume and cluster size ratio (specimen volume [cm³]/cluster size [cm]) were calculated. The median value was 17 cm³/cm.

**Comparisons between radiologist-conducted and operator-conducted wire localization group**

In the operator-conducted wire localization group, the median operation time was 64 minutes (35–155). In the group where a radiologist conducted wire-localization of lesions, which were then excised by a surgeon, median operation time was 79 minutes (30–145). However, the difference in duration was not statistically significant ($p = 0.111$).

Detection time, the duration from start of incision to confirmation using final specimen mammography, was 42 minutes (19–82) for the group where an operator conducted wire localization, which was significantly less than for the group where a radiologist conducted wire localization (59 minutes [22–110], $p = 0.044$) (Table 1).

When operators conducted wire localization, the median excised specimen volume was 23 cm³, and when radiologists conducted the procedure the median was 33 cm³. However, the difference was not statistically significant ($p = 0.334$). Specimen volume and cluster size ratio (specimen volume [cm³]/cluster size [cm]) was 19 cm³/cm in the radiologist-conducted wire localization group and 15 cm³/cm in the operator-conducted wire localization group. This difference was also not statistically significant ($p = 0.513$) (Table 2).

Additional resection was performed when specimen mammography showed that target microcalcifications had not been included in the specimen, or were insufficient in the specimen. Additional resection rate was 25.0% (5/20) for radiologist-conducted wire localization, and 30.4% (7/23) for operator-conducted wire localization respectively, and the difference was not statistically significant ($p = 0.479$).

Based on our surgical experience, we hypothesized that affected breast size, and target microcalcification cluster size, would affect operation duration, especially detection time. We therefore analyzed detection time differences by dividing the patients into larger breast volume and smaller breast volume groups, and larger cluster size and smaller cluster size groups, with varying degrees of size determining size criteria. Detection time stratified by breast volume did not show a significant difference between groups, while operation duration in the large cluster size group (target cluster size 2.5 cm or more) was significantly shorter compared to the smaller cluster size group (41 minutes vs. 57 minutes, $p = 0.032$).

There was no difference in estimated breast volume or target cluster size between the two groups, depending on wire localization conductor. However, taking into account the above result that operator conducted localization detection time could be affected by these two variables, multivariate analysis was conducted using linear regression models. Operator conducting localization was the only variable that significantly reduced detection time ($p = 0.018$), while large cluster size or large breast volume did not significantly affect detection time (Table 3).

### Table 1. Comparison of operation time and detection time between radiologist- and operator-conducted wire localization

<table>
<thead>
<tr>
<th>Variable</th>
<th>Localization by radiologist (n = 17)</th>
<th>Localization by operator (n = 21)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operation time (min)*</td>
<td>79 (30–145)</td>
<td>64 (35–155)</td>
<td>0.111</td>
</tr>
<tr>
<td>Detection time (min)*</td>
<td>59 (22–110)</td>
<td>42 (19–82)</td>
<td>0.044</td>
</tr>
</tbody>
</table>

*Median (range).

### Table 2. Comparison of excised specimen volume and specimen volume/cluster size ratio between radiologist- and operator-conducted wire localization

<table>
<thead>
<tr>
<th>Variable</th>
<th>Localization by radiologist (n = 20)</th>
<th>Localization by operator (n = 23)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Specimen volume (cm³)*</td>
<td>32.9 (2.3–98.0)</td>
<td>25.3 (4.5–81.6)</td>
<td>0.334</td>
</tr>
<tr>
<td>Specimen volume/cluster size (cm³/cm)*</td>
<td>19.0 (1.5–50.9)</td>
<td>15.5 (4.1–93.8)</td>
<td>0.513</td>
</tr>
</tbody>
</table>

*Median (range).
**DISCUSSION**

In most cases, a radiologist performs the localization procedure for indeterminate microcalcification. A surgeon then reviews mammogram images documenting the localization procedure, before deciding upon excision location. However, determining the position of the localization wire (inserted by someone else) and targeting the microcalcification can be challenging, and surgeons find it particularly difficult to operate if the wire is placed slightly off from the target microcalcification [6].

The authors of the present study expected that excisions could be more accurate and prompt if operators themselves conducted wire localizations prior to surgery, because they would be more aware of where the wires were inserted. Although in general, surgeons are not overly familiar with mammography-guided wire localization, it is a relatively simple procedure. If surgeons team up with well-trained radiological technicians, the challenges diminish.

In the present study, the median operation duration was 64 minutes when the wire localization was performed by the operator and 79 minutes when it was performed by a radiologist, with no significant difference between the two groups \((p = 0.111)\). We hypothesized that breast size or breast parenchyma properties, could affect operation duration, in terms of conducting parenchyma approximation and skin closure, after completion of excision. Therefore, a new variable, “detection time” was investigated and compared between the two groups. This describes the time taken from skin incision to final specimen mammography (a point when operators ensure that the excised specimen includes the target cluster of microcalcifications). The results were then compared again. Detection time was significantly shorter when an operator conducted wire localization (Table 1).

From the surgeon’s perspective, if a localized excision is performed on the same target microcalcification, a bigger excision for a bigger specimen exposes target tissue more easily and quickly. Although unnecessary surrounding tissue may be included, this may negate the need for an additional resection due to the exclusion of target microcalcifications [8]. In the present study, depending on the conductor of wire localization, median excised specimen volume was 33 cm\(^3\) and 23 cm\(^3\), specimen volume/cluster size was 19 cm\(^3\)/cm and 15 cm\(^3\)/cm, both of which were not significantly different. Thus, we conclude that differences in operation times and detection times were not due to rough excisions performed on either group. There was also no significant difference in additional resection rate between the two groups (Table 2).

Another merit of operator-conducted wire localization is that, although we cannot show it in quantifiable terms, the incision direction or locations, and wire insertion direction or intraparenchymal wire lengths, can be adjusted to the surgeons’ preference, taking into consideration the possibility of a second operation. This is just as important as providing the operator with location information for the microcalcification.

The main limitation of this study is that due to its small data pool, it does not hold statistical power. Additionally, differences in anesthetic method, need for combined operations, and individual competence in wire localization procedure, may have affected our result. However, the significant differences illustrated by variable “detection times” introduced by the authors to offset inherent data limitations, merits the benefit of operators conducting wire localization. With increased numbers of procedures conducted and resultant enhanced skills for wire localization procedures, the results that the authors desire are expected to be demonstrable. A well-designed prospective study that controls patient/operation factors and operators’ ability to perform wire localization is required to clarify the benefits of operator’s conductance of this procedure.

In conclusion, operator conducted wire localization for indeterminate microcalcification excision may contribute to reduction of operation times without increasing the extent of excision, or increasing the risk of additional excisions, by providing an understanding of target microcalcifications and wire location prior to operation. There may also be additional benefits from choosing the direction of wire insertion.

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**Table 3. Multivariate analysis for possible variables influencing detection time**

<table>
<thead>
<tr>
<th>Variable</th>
<th>B</th>
<th>SE</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Localization by operator</td>
<td>-24.6</td>
<td>9.9</td>
<td>0.018</td>
</tr>
<tr>
<td>Larger cluster size (2.5 cm or more)</td>
<td>-14.2</td>
<td>10.7</td>
<td>0.192</td>
</tr>
<tr>
<td>Larger breast volume (450 cm(^3) or more)</td>
<td>17.3</td>
<td>10.4</td>
<td>0.104</td>
</tr>
</tbody>
</table>

**Table 3. Multivariate analysis for possible variables influencing detection time**

B = unstandardized coefficients; SE = standard error.
CONFLICT OF INTEREST

The authors declare that they have no competing interests.

REFERENCES