Breast model and curriculum for learning the stereotactic biopsy improves radiology resident confidence and efficiency.

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Authors: J. Gibbons, N. Thayil, J. Brooks; Boston, MA/US
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Aims and objectives

Speed and accuracy are essential during stereotactic breast biopsy to minimize pain and discomfort experienced by patients. However, acquisition of procedural skills requires hands-on experience, and traditional radiology residency curricula requires inexperienced residents to learn by practicing on patients, which is not ideal for the patient or resident [1]. Patients presenting for stereotactic biopsy are not only made physically uncomfortable during the procedure, but also experience anxiety and stress surrounding both the diagnostic procedure itself and the anticipated diagnosis [1,2]. Having an inexperienced resident perform the biopsy causes not only increased stress, anxiety, and discomfort for the patient, but also increased stress and anxiety for the resident [1,3]. Furthermore, integrating residents into the procedure is often difficult and avoided by faculty, not only due to reasons described above, but also because of the increased time it takes to teach residents how to perform the procedure, which is a burden when work load is high [1]. All of these factors lead to a poor learning experience and inadequate exposure to stereotactic biopsies.

Studies have shown that simulation models are necessary in resident education to gain skills and reduce patient harm and discomfort [1,3,4].

We propose that a breast simulation model can serve as an educational tool to help residents attain the procedural skills necessary to perform stereotactic biopsies in an efficient and competent manner, while limiting possible harm and discomfort to patients. The aim of this study is to create a supplemental stereotactic breast biopsy curriculum to be administered to residents, which would include both a simulation model and a didactic presentation, and to survey resident confidence level in performing stereotactic biopsies before and after administration of this new curriculum.

Methods and materials

Third and fourth year radiology residents at our institution were asked to participate in the study. Out of 19 residents, 17 agreed and participated to the study’s completion.

The residents were first asked to complete a pre-curriculum survey, which assessed the following on a 5 point scale (1=strongly disagree, 5=strongly agree): individual level of confidence in their ability to perform accurate stereotactic biopsies, whether they felt they had received adequate patient experience to perform stereotactic biopsies, whether they would like to use a tissue model to practice stereotactic biopsies, and whether a presentation on preparation for stereotactic biopsy would be helpful in learning the
procedure as part of the breast imaging resident curriculum. Of note, all of these residents had been exposed to at least one 4-week breast imaging rotation under the traditional curriculum prior to this study.

Residents were then provided with PowerPoint lectures containing information on procedural pre-planning and step-by-step instructions on how to skillfully execute a stereotactic breast biopsy, which they reviewed on their own to eliminate presenter variability. The pre-planning portion of the lecture reviewed setting up for the procedure, interviewing the patient, determining which diagnostic procedure is most appropriate for the clinical setting, and how to decide on the best biopsy approach using prior imaging. The step-by-step instructions gave residents an effective technique to use when practicing with the simulation models, in addition to reviewing common pitfalls to avoid when performing stereotactic biopsies.

Breast simulation models were created using a cooked turkey product to simulate breast tissue (Fig. 1 on page 6). The meat products were kept in shrink-wrap to maintain cleanliness and 2 small slits were placed in the packaging to allow drainage of any accumulated fluid. A crushed eggshell suspension was created and injected into the meat products to simulate calcifications within breast tissue.
Fig. 2: Scout image of the breast model containing an injected eggshell suspension, simulating calcifications. (black air-filled holes indicate locations of prior simulated biopsy with the same model)

References: Boston University, Boston Medical Center - Boston/US

To create the suspension, eggs were cracked in half, the albumen and yolk were discarded, and the inner membrane of the shells was peeled off. The bare shell was then ground in a mortar and pestle to reach a particle size small enough to fit a 13-gauge needle. A small amount of this ground eggshell was then mixed with 5 milliliters of hair gel. To inject the suspension, 2 milliliters were drawn up in a small syringe and injected into the center of the meat product using a 13-gauge needle (Fig. 3 on page 8). To adequately expose the meat product models so that the simulated calcifications could be seen, manual settings of 95 mAs and 35 kVp were used with standard 2D mammography [5].
Residents then participated in a hands-on session performing stereotactic biopsies with the breast simulation models (Fig. 4 on page 9, Fig. 5 on page 9).

Fig. 6: Breast simulation model ready for simulated stereotactic biopsy procedure. Calcifications are extracted from the model with the biopsy device. Residents confirmed extraction of calcifications with specimen radiograph.

References: Boston University, Boston Medical Center - Boston/US

Following their experience, residents completed post-curriculum surveys, which assessed the subjective effectiveness of the curriculum and residents’ overall comfort level with performing stereotactic breast biopsies. The survey assessed the following on a 5 point scale (1=strongly disagree, 5=strongly agree): individual level of confidence in their ability to perform accurate stereotactic biopsies, whether the tissue model experience was an adequate substitute for performing accurate stereotactic biopsies, whether they felt the tissue model experience is beneficial to the radiology residency breast imaging curriculum, and whether the PowerPoint lectures were helpful in learning the stereotactic biopsy procedure in preparation for the tissue model experience.

An example of the post-fire set of stereotactic images is seen below.
Fig. 5: Post-fire stereo pair. Calcifications are aligned with biopsy aperture.

References: Boston University, Boston Medical Center - Boston/US

Scores from each pre- and post-curriculum survey statement were averaged. Residents’ perception of the curriculum effectiveness was deduced by comparing the average score of each statement from the pre-curriculum survey to the corresponding statement from the post-curriculum survey.

Images for this section:
Fig. 1: Example mammogram of model showing simulated calcifications.
Fig. 2: Scout image of the breast model containing an injected eggshell suspension, simulating calcifications. (black air-filled holes indicate locations of prior simulated biopsy with the same model)
**Fig. 3:** Crushed eggshell suspension ready to be injected into a breast model.

**Fig. 4:** Pre-fire stereo-pair. Target (calcifications) just in front of the needle tip.
Fig. 5: Post-fire stereo pair. Calcifications are aligned with biopsy aperture.
**Fig. 6:** Breast simulation model ready for simulated stereotactic biopsy procedure. Calcifications are extracted from the model with the biopsy device. Residents confirmed extraction of calcifications with specimen radiograph.
## Results

<table>
<thead>
<tr>
<th>Question</th>
<th>Avg. Pre-curriculum Score</th>
<th>Avg. Post-curriculum Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>I am confident in my ability to perform accurate stereotactic biopsies</td>
<td>1.7</td>
<td>4</td>
</tr>
<tr>
<td>Pre: I have received adequate patient experience in my breast rotations to perform stereotactic biopsies</td>
<td>1.8</td>
<td>4.8</td>
</tr>
<tr>
<td>Post: The tissue model experience was an adequate substitute for performing accurate stereotactic biopsies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: I would like to be able to use a tissue model to practice stereotactic biopsies</td>
<td>4.9</td>
<td>5</td>
</tr>
<tr>
<td>Post: This tissue model experience is beneficial to the breast imaging curriculum in the radiology residency program</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pre: A presentation on preparation for stereotactic biopsy would be helpful in learning the stereotactic biopsy procedure as part of the breast imaging curriculum</td>
<td>4.9</td>
<td>4.7</td>
</tr>
<tr>
<td>Post: The pre-presentation on preparation for a stereotactic biopsy was</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
helpful in learning the stereotactic biopsy procedure in preparation for taking part in the tissue model experience

The above statements were assessed on a 5-point scale (1=strongly disagree, 5=strongly agree) by residents on pre- and post-curriculum surveys. The scores listed above are averages from surveys taken by the 17 residents included in this study.

Conclusion

Evaluation of pre- and post-curriculum surveys shows that residents overwhelmingly consider their experience with the breast simulation models to be educationally useful.

Prior to participating in the curriculum, residents did not feel confident in their abilities to perform stereotactic biopsies, as evidenced by an average score of 1.7 on the pre-curriculum survey, meaning the residents on average did not agree that they were confident in their ability to perform accurate stereotactic biopsies. After participation in the curriculum, resident confidence increased to an average score of 4. Also prior to the curriculum, residents felt they had not had adequate patient experience to perform stereotactic biopsies, indicated by an average score of 1.8, but felt after participation in the curriculum that the tissue model experience was an adequate substitute for performing accurate biopsies, indicated by an average score of 4.8. Pre- and post-curriculum average scores of 4.9 and 5, respectively, indicate that residents would like to be able to use a tissue model to practice stereotactic biopsies, and that the model experience is beneficial to breast imaging curriculum during radiology residency. Furthermore, pre- and post-curriculum average scores of 4.9 and 4.7, respectively, indicate that residents believe a presentation on preparation for and performing a stereotactic biopsy procedure is helpful and essential to radiology residency breast imaging curriculum.

We therefore conclude that a breast simulation model is a useful educational tool that allows residents to become comfortable with and skilled at performing stereotactic breast biopsy procedures prior to performing them on patients.

Personal information
Julie Gibbons, MD
Radiology Resident, PGY-2
Boston University, Boston Medical Center
julie.gibbons@bmc.org

Neil Thayil, MD
Radiology Resident, PGY-4
Boston University, Boston Medical Center
neil.thayil@bmc.org

Jeffrey Brooks, MD
Assistant Professor of Radiology
Boston University School of Medicine, Boston Medical Center
jeffrey.brooks@bmc.org

References


