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# Cross-Residency Radiologic/Pathologic Correlation Curriculum: Teaching Correlation of Surgical Specimens With Imaging

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**Abstract**

The College of American Pathologists expects pathologists to attain competency in radiologic/pathologic correlation, including correlation of histopathologic findings with imaging findings. While pathology residents appreciate the importance of radiologic/pathologic correlation, their lack of experience and confidence in interpreting imaging studies deters them from obtaining specimen radiographs and reviewing preoperative imaging studies. Formal training in this domain is lacking. A cross-residency curriculum was developed to help pathology residents build basic skills in the correlation of surgical specimens with preoperative imaging and specimen radiographs. Didactic sessions were prepared by 3 pairs of radiology and pathology residents with guidance from radiology and pathology attendings in the subspecialty areas of breast, musculoskeletal, and head and neck. The authors describe the development, implementation, and assessment of the curriculum. A total of 20 pathology residents attended the sessions, with 7 completing both the pre- and postintervention surveys. These residents gained confidence in their ability to interpret specimen radiographs and to select specimens to evaluate with radiography. They gained an appreciation of the importance of collaboration with radiologists in evaluating specimens and of viewing preoperative imaging studies to guide gross examination and dissection. They reported obtaining specimen radiographs and viewing preoperative imaging studies more frequently after attending the sessions. Innovative solutions such as this cross-residency educational initiative offer a potential solution to fulfill the radiologic/pathologic correlation competency standard for pathology residents and may be replicable by other residency programs and academic institutions.

**Keywords**

cross-residency curriculum, medical education, pathology residency, radiologic/pathologic correlation, specimen radiographs

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## Introduction

During residency training, a pathology resident learns the value and practice of integrating clinical, pathologic, and radiologic information when rendering an accurate diagnosis. The importance of radiologic/pathologic correlation is recognized by professional societies, including the College of American Pathologists (CAP). College of American Pathologists

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developed a competency model for pathologists, which recommends specific competencies for pathologists. The model is intended to provide guidance for pathologists as they complete residency training, prepare for board recertification, participate in continuing medical education, maintain certification requirements, and improve their performance. In this model, radiologic/pathologic correlation is an essential competency area related to the practice of pathology across multiple subspecialties, including breast pathology, musculoskeletal pathology, and head and neck pathology, whereby pathologists must understand the importance of communication between pathologists and radiologists in evaluating specimens obtained with image guidance, recognize the importance of radiographic information in ensuring optimal pathologic evaluation, suggest additional steps when the initial pathologic examination does not identify the targeted lesion, correlate the histopathologic findings with imaging and clinical findings, and recommend a course of action to resolve discrepancies between pathology and imaging.[1]

Incorporation of clinical and radiographic information is also critical in specimen grossing of many different tissue types in adults and children, including breast, musculoskeletal, head and neck, gastrointestinal, gynecologic, and perinatal specimens.[1] Both viewing preoperative imaging and obtaining specimen radiographs can reveal important details about the underlying pathology, aid in the gross examination and dissection of the specimen, highlight areas that may be important to examine histologically, correlate the expected findings with the gross anatomic findings, confirm that the clinical lesion was entirely removed, and assist the pathologist in building a differential diagnosis.[2] In fact, it is routine practice at our institution for all excisional breast specimens performed on lesions targeted by imaging to undergo postoperative examination by specimen radiography. These imaging studies are critical in documenting that the targeted lesion was removed and to aid in the examination and sampling of the tissue for histologic evaluation.[2-4] Another subspecialty area where radiologic/pathologic correlation is essential is in the domain of musculoskeletal pathology, where the combination of anatomic site, age of the patient, radiographic features, and histopathology helps determine the correct diagnosis.[3,5]

At our institution, radiologic/pathologic correlation is practiced individually by pathologists reviewing clinical cases and collaboratively with radiologists at various interdepartmental conferences. Although pathology residents are expected to practice radiologic/pathologic correlation, formal instruction in the interpretation of specimen radiographs and the correlation of surgical specimens with preoperative imaging was not offered within our institution's Pathology Residency Training Program. For that reason, we organized a cross-residency curriculum to address this deficiency, whereby radiology residents served as peer teachers to pathology residents. Here we describe the development, implementation, and initial success of this curriculum as instituted at Brigham and Women's Hospital/Harvard Medical School.

## Materials and Methods

The Pathology Residency Training Program at Brigham and Women's Hospital consists of approximately 9 residents in Anatomic Pathology and 2 to 3 residents in Clinical Pathology per year, for a total of approximately 38 residents in Anatomic and Clinical Pathology. Pathology residents obtain specimen radiographs and view preoperative imaging only when they personally deem it a matter of clinical necessity. In the current state, the Pathology Residency Program offers no formal training in when and how to interpret specimen radiographs nor when and how to correlate surgical specimens with preoperative imaging studies.

### *Development of the Cross-Residency Radiologic/Pathologic Correlation Curriculum*

In January 2018, a then first-year radiology resident (A.K.D.) and a first-year pathology resident (M.S.D.) initiated development of a new curriculum to address this deficit. For guidance and support, we identified 2 faculty advisors: J.E.B, the chief of the Breast Service from the Department of Pathology, and S.A.M, associate program director of the Diagnostic Radiology residency from the Department of Radiology, who is also a member of the Education Leadership Committee of the Brigham Education Institute, a center which aims to facilitate the design and implementation of educational initiatives. We also received support from the educational leadership of both the Pathology and Radiology Residency Programs and from Edward Krupat, PhD, director of the Center for Evaluation at Harvard University.

This curriculum sought to satisfy 2 primary objectives with regard to the training received by pathology residents: (1) to provide them with basic skills in radiologic/pathologic correlation of surgical specimens with preoperative imaging and specimen radiographs and (2) to increase the residents' confidence in seeking to obtain and complete the interpretation of specimen radiographs. Six months before the curriculum was to be implemented, we identified the following subspecialty areas as challenging and particularly relevant for accurate pathology diagnosis and cancer staging: breast, head and neck, and bone and soft tissue. Three pairs of radiology and pathology residents were mentored by radiology and pathology attendings in the 3 subspecialty areas. We provided each resident pair with a suggested outline for the didactic session and learning objectives, which was a modified version of the CAP Competency Model for Pathologists.

### *Structure and Implementation of the Cross-Residency Radiologic/Pathologic Correlation Curriculum*

*Didactic sessions.* Three months before the scheduled curriculum session, the 3 pairs of radiology and pathology residents met with their subspecialty radiology and pathology attendings to design the 20- to 30-minute didactic sessions in the format of case-based presentations. The breast session was held on

October 17, 2018. The head and neck and musculoskeletal sessions were jointly held on October 31, 2018. These sessions were offered again in November 2019. The sessions were integrated into the longitudinal pathology and radiology curricula and offered during each program's regularly scheduled morning didactic conferences. Both pathology and radiology residents were required to attend.

The learning objectives for the breast session included: (1) understand the importance of communication between pathologists and radiologists in evaluating specimens obtained with image guidance, (2) recognize the importance of radiographic information (including reviewing specimen radiographs) in ensuring optimal pathologic evaluation, and (3) correlate the histopathologic findings with imaging and clinical findings. The suggested outline for the presentation was for the teachers to review relevant anatomy and anatomical landmarks using mammography and share typical mastectomy and lumpectomy cases containing masses, calcifications, radioactive seeds, and surgical clips. In the case discussions, the peer teachers reviewed relevant preoperative imaging studies (mammography and breast ultrasound) and postoperative specimen radiographs.

The learning objectives for the head and neck session included: (1) recognize the importance of radiographic information in ensuring optimal pathology interpretation and (2) correlate the histopathologic findings with imaging and clinical findings. The suggested outline for the presentation was for the teachers to review relevant anatomy and anatomical landmarks using computed tomography (CT) and share typical mandibulectomy and maxillectomy cases where specimen radiographs were performed and correlated with preoperative imaging. In the case discussions, the peer teachers reviewed relevant preoperative imaging studies (CT and positron emission tomography/CT) and postoperative specimen radiographs.

The learning objectives for the bone and soft tissue session included: (1) integrate clinical history, laboratory findings, and radiographic findings with the morphologic assessment and (2) correlate the histologic findings with imaging findings to determine size and local behavior of the bone tumor, including radiograph and magnetic resonance imaging (MRI) examples. The suggested outline for the presentation was for the teachers to review relevant anatomy and anatomical landmarks using radiography and to present select osseous resections where specimen radiographs were performed and correlated with preoperative imaging. In the case discussions, the peer teachers reviewed relevant preoperative imaging studies (radiography, CT, and MRI) and postoperative specimen radiographs.

*Survey.* The Brigham and Women's Hospital's Institutional Review Board reviewed the research proposal and granted an exempt research determination (protocol # 2018P001808) because the research was determined to not be in the purview of human subject's research. After receiving an exemption from the Brigham and Women's Hospital's Institutional Review Board, we created an anonymous Pre-Intervention Survey Instrument (Supplemental Appendix 1) and Post-Intervention Survey Instrument to evaluate the curriculum's effectiveness by the participating pathology residents. The surveys were housed on REDCap (Research Electronic Data Capture) hosted by Partners HealthCare Research Computing, Enterprise Research Infrastructure & Services group. REDCap is a secure, web-based application designed to support data capture for research studies.

Before the sessions and again 6 weeks after the sessions, we invited the pathology residents to complete the survey to assess how confident they felt in their ability to interpret specimen radiographs, how satisfied they were with their current training, what they perceived was the importance of radiologic/pathologic collaboration and of viewing preoperative imaging studies, and how frequently they obtained specimen radiographs and correlated surgical specimens with preoperative imaging studies.

## Results

Of the approximately 20 pathology residents who attended the sessions, 10 completed the preintervention survey and 7 completed both the pre- and postintervention surveys; therefore, the sample size whose paired responses were compared and analyzed was 7. All of the subjects were enrolled in either the Anatomic Pathology or combined Anatomic and Clinical Pathology Residency Program, and most (n = 5/7 [71%]) were either first- or second-year pathology residents. The attendance at the 3 didactic sessions varied among subjects.

The preintervention survey respondents reported an overall lack of confidence in interpreting specimen radiographs and preoperative imaging studies (Figure 1A). Although they acknowledged the importance of radiologic/pathologic collaboration and of viewing preoperative imaging studies (Figure 1B), they infrequently obtained specimen radiographs and viewed preoperative imaging studies (Figure 1C). When comparing pre- and postintervention survey results, the respondents reported they had gained confidence in their ability to interpret specimen radiographs and to select specimens to evaluate with radiography (Figure 2A). They gained an appreciation of the importance of collaboration with radiologists in evaluating specimens and of viewing preoperative imaging studies to inform gross examination and dissection (Figure 2B). They reported obtaining specimen radiographs and viewing preoperative imaging studies more frequently after attending the sessions (Figure 2C).

## Discussion

As demonstrated by the survey results, we believe pathology residents can achieve competency in radiologic/pathologic correlation by participating in a cross-residency educational initiative that uses radiology residents to teach pathology residents. While the pathology residents we surveyed appreciate the importance of radiologic/pathologic correlation, their lack of confidence in interpreting imaging studies seems to deter them from obtaining specimen radiographs and viewing preoperative imaging studies. Although our current study

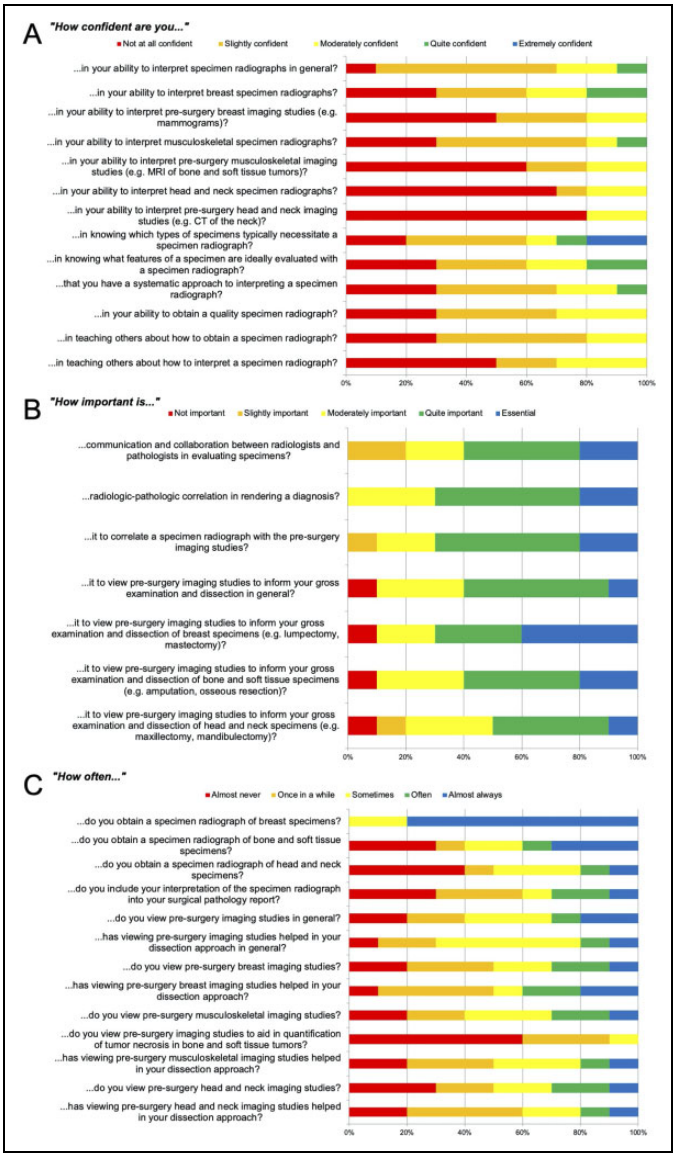


**Figure 1.** Preintervention survey results among 10 pathology resident respondents across multiple domains. A, Preintervention survey results measuring level of confidence in interpreting specimen radiographs and preoperative imaging studies. B, Preintervention survey results measuring level of importance of radiologic/pathologic collaboration and viewing preoperative imaging studies. C, Preintervention survey results measuring level of frequency of obtaining specimen radiographs and viewing preoperative imaging studies.

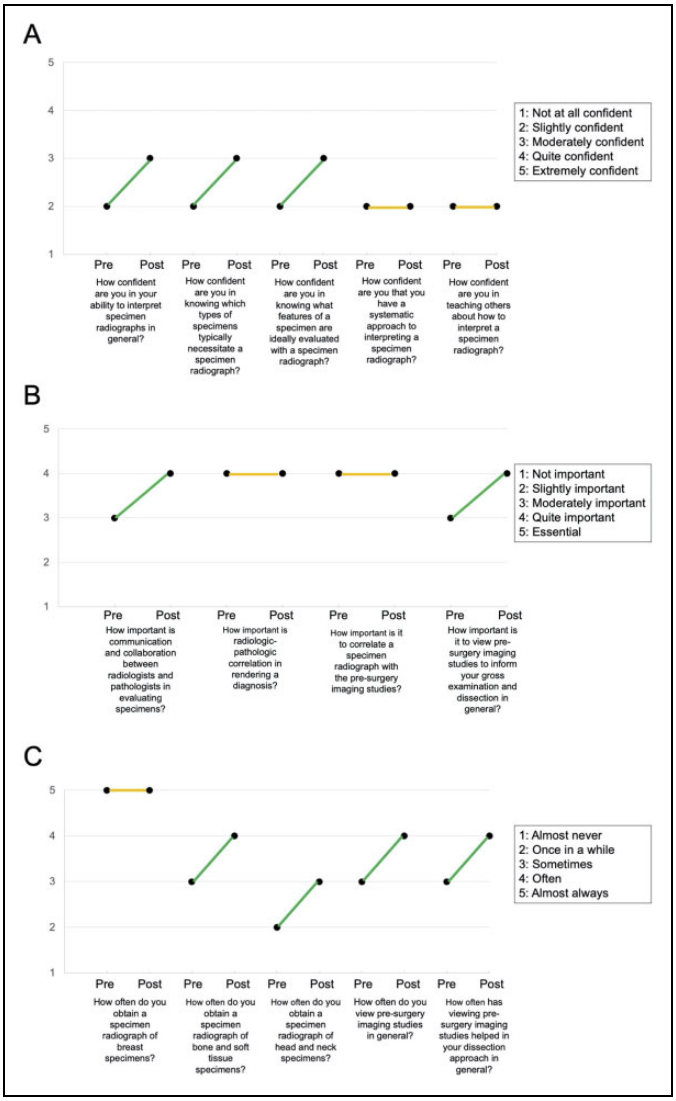


**Figure 2.** Comparison of pre- and postintervention survey results among 7 pathology resident respondents across multiple domains. A, Comparison of pre- and postintervention survey results measuring level of confidence in interpreting specimen radiographs and selecting specimens to evaluate with radiography. B, Comparison of pre- and postintervention survey results measuring level of importance of collaboration with radiologists in evaluating specimens and viewing preoperative imaging studies. C, Comparison of pre- and postintervention survey results measuring level of frequency of obtaining specimen radiographs and viewing preoperative imaging studies.

demonstrates that this curriculum offers a potential solution to fulfill the CAP's radiologic/pathologic correlation competency standard for pathology residents, this curriculum has not yet been implemented at other institutions. Further analysis will be required once it has been introduced in other settings and institutions.

If this curriculum and its positive outcomes prove reproducible at other institutions, it could be implemented in multiple pathology residency programs as a means to fulfill the CAP's radiologic/pathologic correlation competency standard for pathology residents. This curriculum could easily complement other formal, comprehensive programs designed to help pathology residents attain competence in this domain. For further study, this curriculum with pre- and postintervention surveys could be adopted by other academic institutions. The ideal study would be longitudinal, following pathology residents over the course of their training to assess the ways in which this curriculum, in addition to natural on-the-job learning, enables them to hone skills in radiologic/pathologic correlation. Additionally, it would be interesting to measure the effect of this curriculum on pathology residents' interest in attending radiologic/pathologic correlation conferences and/or pursuing

careers in academic medicine. Elements of this curriculum, specifically the case-based discussions, could also be adapted and integrated into radiology and pathology electives in medical school.

We believe that several factors contributed to the success of this curriculum, including resident leadership in all aspects of the curriculum, from development to implementation and integration into the longitudinal pathology residency curriculum. Just as crucial was the support of the educational leadership within both Pathology and Radiology Residency Programs to provide the conference time, including both program directors and our 2 faculty advisors (J.E.B. and S.A.M.).

However, we note several limitations related to how we measured the effectiveness and success of the curriculum. Only 7 of 20 pathology residents completed both the pre- and post-intervention surveys, which is a small sample size with limited power. Therefore, the data we analyzed may not be representative of all pathology residents in the audience. Additionally, due to the small number, statistical analysis lacked power. Some attendees may not have had enough time or motivation to complete the surveys. Finally, the pathology residents who completed the surveys may have been more interested in radiologic/pathologic correlation than their counterparts.

In the future, the authors intend to continue offering these sessions to first-year pathology residents and to any other senior pathology residents who are interested in reviewing the topic. They also plan to design and implement additional sessions in other subject areas, such as perinatal skeletal surveys and thoracic imaging.

## Authors' Note

Mia S. DeSimone and Ariadne K. DeSimone contributed equally to this work.

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## Supplemental Material

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