Pathology Specimen Radiograph Co-Registration Using the HoloLens Improves Physician Assistant Workflow

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Background

Augmented reality (AR) allows virtual data to be superimposed on real-time natural surroundings. Such AR applications are being increasingly used in medicine, predominantly in the surgical subspecialties [1-2]. They offer novel mechanisms for education, simulation, 3D imaging and for performing telemedicine. This technology provides an opportunity to replace time consuming and cumbersome practices with more efficient contemporary workflows.

Pathology laboratories manually examine and dissect surgically removed specimens from patients. Such gross examinations often require the person dissecting these specimens to consult radiology images to look for correlating pathology and/or embedded metal clips. There is a need to improve this onerous workflow and to better perform radiology-pathology correlation. The aim of this study was to determine whether the Microsoft HoloLens could be employed to enhance these tasks by performing them in an AR setting.

Case Presentation

Guidelines for radiology-pathology correlation of breast biopsy clip placement and their retrieval after surgical removal are well established and mandated [3-4]. At our institution, we prospectively selected breast resection specimens that underwent prior radiology-guided biopsy with clip placements. Pathologists’ Assistants were trained to use a HoloLens (Development Edition[5]) during their gross examination and dissection of such specimens. Their current workflow and ability to locate metal clips from biopsy sites was compared to performing this task using radiograph-specimen co-registration with a HoloLens device (Figure 1). Radiographic images were viewed via remote desktop using the Microsoft HoloLens Remote Desktop Preview application or HoloLens Photo application. Time to identify biopsy clips was recorded. After the study participants completed a survey based on their experience using a Likert scale.
Outcome

A total of 24 specimens were studied, including 12 mastectomies and 12 lumpectomies, of which 9 had neoadjuvant chemotherapy +/- radiation. Pathology diagnoses included invasive ductal carcinoma (n=20), invasive lobular carcinoma (n=1), atypical ductal hyperplasia (n=1), and papilloma (n=2). The HoloLens permitted radiographs to be co-registered on top of corresponding breast specimens, allowing biopsy clips to be easily detected (Figure 1). Identification of metallic clips averaged 10.6 minutes with the existing manual workflow and 1.5 minutes using the HoloLens. All (100%) users rated the Microsoft HoloLens ≥4/5 as beneficial and usable technology for radiograph-specimen co-registration.

Discussion

This study shows that the HoloLens can be used to enhance clinical workflow. The device permitted users to interact with radiology images and pathology specimens simultaneously in an AR environment. The head mounted device was lightweight, easy to wear, and allowed tasks to be conducted hands-free. Co-registration is fundamental to overlaying 2D or 3D images over objects, such as surgically resected tissue in this study. Co-registration need not always be performed manually, but can be accomplished using a mathematical approach to correlate multiple coordinate systems from different objects [6]. AR systems can reach very high accuracy when combined with a robotic system for surgical procedures [7].
For example, neurosurgery testing of AR using 3D integrated intraoperative imaging proved to have superior accuracy for hardware placement compared to free-hand techniques [8].

Conclusion

Augmented reality applications are emerging in the medical field and can be used to improve traditional workflow. The HoloLens allowed Pathologists’ Assistants in this pilot study to easily perform radiograph-specimen co-registration that diminished the time by 85.5% for them to identify biopsy clips in breast resection specimens. Further testing is required to determine if the HoloLens can be similarly used during gross pathology examination of other specimens.

References


Keywords

augmented reality, co-registration, HoloLens, radiology, pathology