3D Mammography/Tomography

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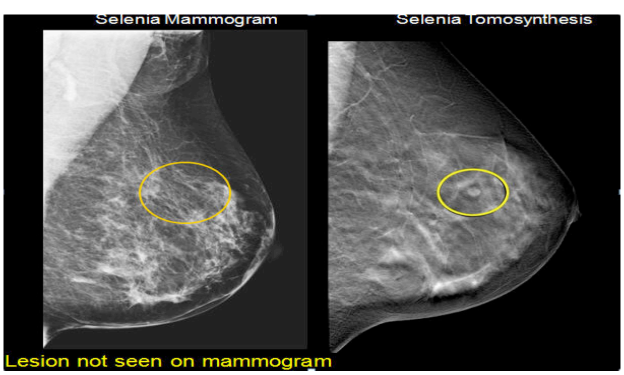
***Abstract*—The practice of mammography to detect the presence of breast cancer has been around for nearly a century. Using low-energy x-rays, radiologists can detect abnormal growths and cancers before they spread throughout the body. Classical mammography is limited in the two-dimensional image it produces, though, and often leaves small tumors undetected or causes normal tissue to appear abnormal. In response to this, biomedical engineers have produced the 3D mammogram using tomosynthesis, allowing radiologists to detect breast cancer much easier.**

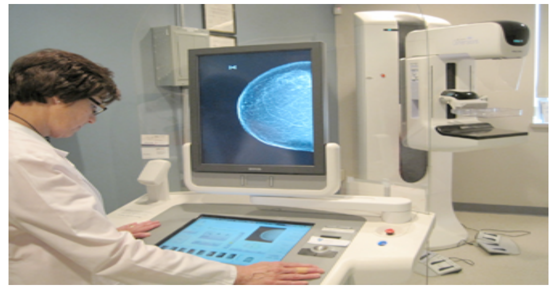
I. Introduction

Breast cancer is the most commonly diagnosed cancer and the second leading cause of death in women. One in eight women will be diagnosed with breast cancer at some point in their life and over 220,000 cases are diagnosed every year in the United States. 40,000 women will die of breast cancer this year in the United States as well. Mammography is used to detect breast cancer and can help reduce death from this disease by 15%, but this detection method is often unclear and causes high amounts of over-diagnosis and under-diagnosis, causing patients to have to return for multiple screenings. This increases breast exposure to radiation, which in itself may cause increased cases of breast cancer. 2D mammography also leaves about 10% of cancers undetected. Due to these problems, engineers have begun to use tomography to produce limited 3 dimensional images of breast tissue.

II. Methods

Tomography utilizes low-level x-ray signals to detect structures within breast tissues, which include milk ducts, lobules, fatty tissues as well as cancerous cells. With a swinging x-ray camera, which produces multiple images of the breast, it is much easier to confidently distinguish cancerous cells from normal tissue when each layer of the breast can be observed separately. X-rays are converted into digital images, which can be looked at by radiologists as a limited 3 dimensional image. Computer Aided Detection (CAD) is often used to assist in determining regions where cancer seems to be present, making cancer detection faster and simpler. Tomosynthesis has higher success in receiving a more accurate reading of structures inside denser breast tissues in comparison to 2D mammography, which is shown in the image below:





III. Results

According to recent studies published online January 7, 2013 in *Radiology,* tomosynthesis increases detection of invasive breast cancers by 40% in comparison to 2D mammography, as well as reduces false-positive readings by 15%. Cancer detection was increased from 6.1 patients out of 1000 examinations to 8.0 per 1000 examinations; a 27% increase. Patient call-backs due to uncertain readings reduced by 20-30% with tomography. Tomography tests do take twice as much time to interpret in comparison to mammography, though, which increases patient exposure to radiation. Calcification fields, which may be precancerous indications, are also more easily interpreted on a 2D image. Another downside to tomography is that it will require more expensive equipment and larger storage archives.

IV. Discussion

Mass General Breast Imaging teams began engineering this device over 10 years ago and it was finally developed and approved by the FDA in February, 2011. Since then, tomosynthesis technologies have spread throughout the U.S. In Washington D.C alone, over 35,000 3D mammograms have been performed since August 2011. Over the next few years, 3D tomography is being planned to add on to already existing 2D mammogram procedures in hospitals around the U.S, but it is presently not a procedure covered by insurance companies. The only major concern for mass-producing these machines for hospital use is the current high cost of production. However, due to the high rate of success for tomography and effectiveness for all women, despite tissue density and family history, it should be widely available for use in hospitals around the U.S within a couple years.

References

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