

Phantom Experiments for Breast Cancer Detection by Ultrasound Transmission Period

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ABSTRACT

In every cancer early detection and early treatment is the best way to decrease mortality of patients. Moreover early detection of breast cancer increases the possibility of breast conservation treatment. Although mammography is the most powerful modality for early detection, it is hazardous to be used for young women due to X-ray exposure. Another modality of image diagnosis is ultrasound echo technique. But it is not so powerful to detect breast cancer compared to mammography. Palpation is another modality, but is largely dependent on the skill and experience of medical doctors. A new technique is tested its validity in phantom experiments with good results.

Key words: Breast cancer, early detection, ultrasound, transmission period, phantom experiments

1. INTRODUCTION

Breast cancer is the 2nd cause of death among Japanese women and 3rd among Korean women.

The disease is related with western style diet and is increasing.

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Although mammography is the most powerful modality for early detection, it is hazardous to be used for young women due to X-ray exposure. Another modality of image diagnosis is ultrasound echo technique. But it is not so powerful to detect breast cancer compared to mammography. Palpation is another modality, but is largely dependent on the skill and experience of medical doctors. A new technique has been proposed theoretically by some of the authors and was named ultrasound transmission technique (1).

In the present report phantom experiments were conducted to obtain good results.

The idea was developed from the clinical findings using ultrasound computed tomography that sound velocity of breast cancer is higher than normal tissue. Carson et al., has reported that the difference of velocity in malignant tumor and in normal tissue of identical patient is more than 41 m/s. The velocity of ultrasound in normal tissue is between 1350 m/s to 1500 m/s depending on the tissue: greater in parenchyma and smaller in fat (2).

A breast to be examined will be sandwiched between a planar ultrasound transducer and reflector plate.

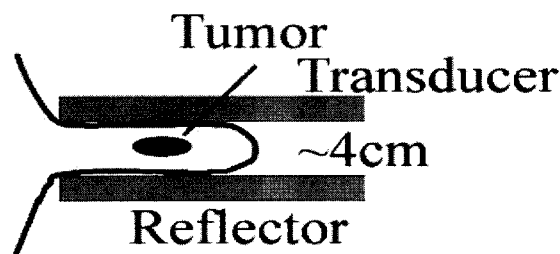


Fig 1. Schematic view of breast examination apparatus to be developed in future.

2. MATERIAL AND METHOD

Phantom experiments were conducted to verify the validity of the technique. Toshiba Ultrasound Diagnostic System SSA-390A with linear transducer of 9MHz was employed for the experiment. At first sound velocity of Plexiglas to be used in the phantom experiment was measured by echo technique. Plexiglas phantom emerged into the degassed water is shown in Fig.2.

The sound velocity of the Plexiglas was measured to be 2670 m/s compared to the published datum of 2720 m/s, where sound velocity was assumed to be 1510 m/s according to the published datum.

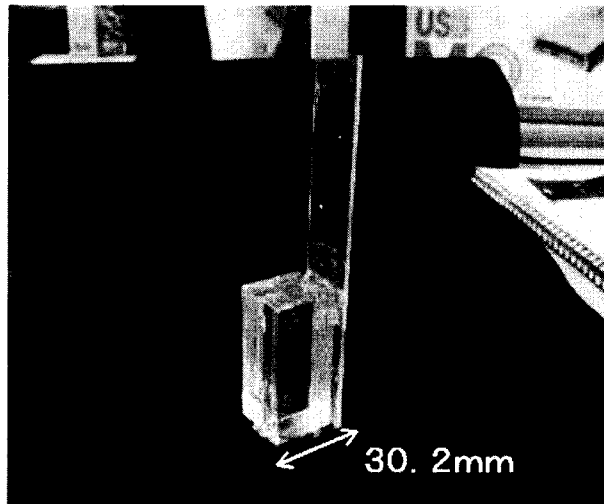


Fig. 2. Plexiglas specimen to measure sound by ultrasound echo technique.

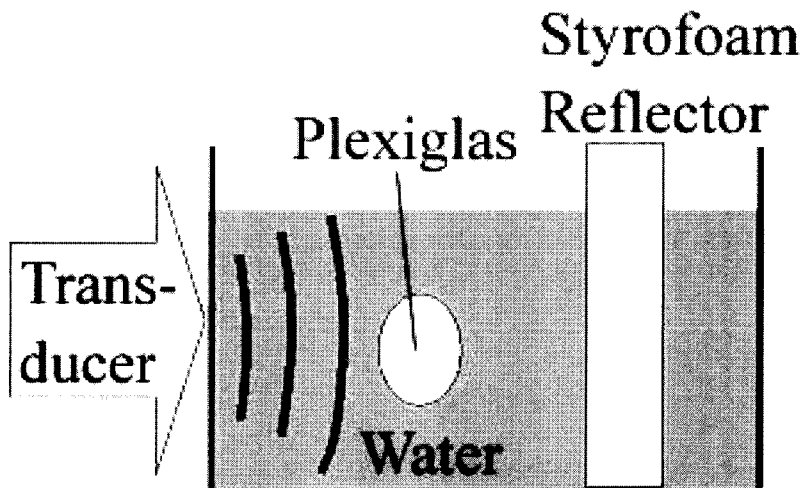


Fig. 3. Schematic view of phantom experiment.

Second four Plexiglas (PMMA) plates of the thickness of each 3mm and widths of 15mm were put between the Styrofoam reflector and ultrasound transducer in degassed water.

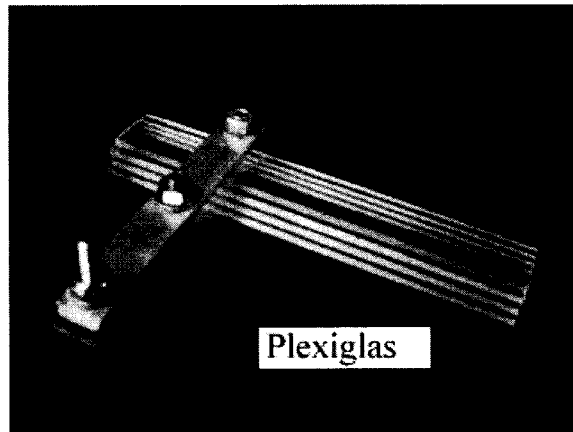


Fig. 4. Plexiglas plates used for phantom experiment.

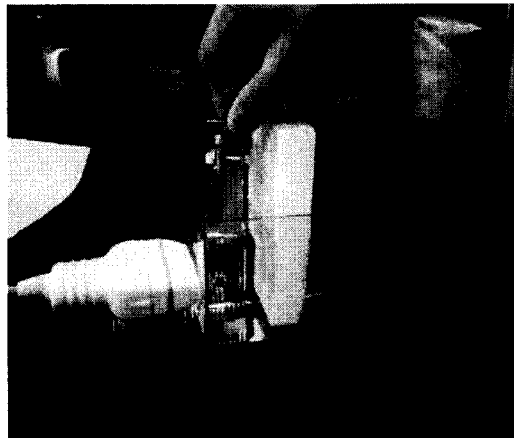


Fig. 5. Picture of the phantom experiment

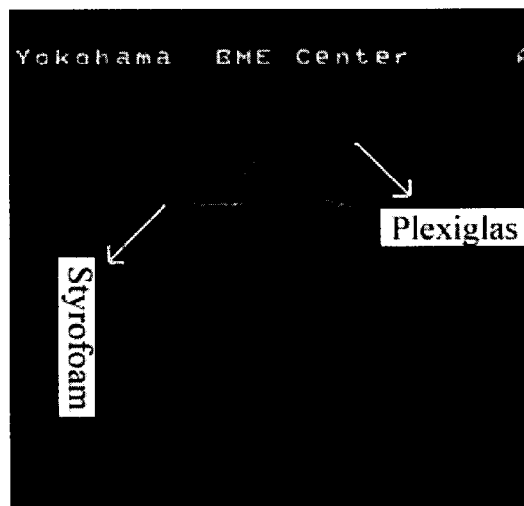


Fig. 6. Echogram obtained by the phantom experiment

3.RESULTS

In the resultant echogram the apparent distance between Styrofoam and transducer were shortened due to higher velocity of sound wave in Plexiglas(2700m/s) than degassed water(1510m/s). The apparent shortening coincided well with the theoretical expectation. This showed the validity of the method. A breast to be examined will be sandwiched between a planar ultrasound transducer and reflector plate.

Resultant echogram of the reflector seems to apparently nearer at the location of breast cancer than normal tissue. Further Phantom experiments will be reported at the meeting using lower sound velocity compared

REFERENCES

1. Y.Hayakawa, T.Inada, E.Ueno et al, "Mass Screening of Breast Cancer by Ultrasound Transmission Technique---Theoretical Considerations." Japn. J. Appl. Phys. 24(Suppl. 24-1), 82-83, 1984.
2. P.L.Carson, A.L.Scherzinger, P.H.Brand et al., Ultrasonic Examination of the Breast (John Wiley & Sons, Chichester, 1983) pp.187.