The Shimadzu Users' Group (FPD R/F System Application Research Group) was introduced in Topics in Medical Now No. 68. The six presentations related to Shimadzu SONIALVISION safire applications given at the first meeting of this group are introduced below.

Potential of Low-Dose Tomosynthesis for Lung Cancer Screening

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Introduction

We have been investigating the application of tomosynthesis to lung cancer screening at this hospital. Chest tomosynthesis can visualize nodules overlaid by the ribs or collar bones, which are difficult to identify by plain radiography. It has proved useful for picking up lesions that are targets for treatment **(Fig. 1)**. However, as screening is performed on healthy patients, it is desirable to further reduce the X-ray exposure dose of chest tomosynthesis when it becomes adopted for actual screening.

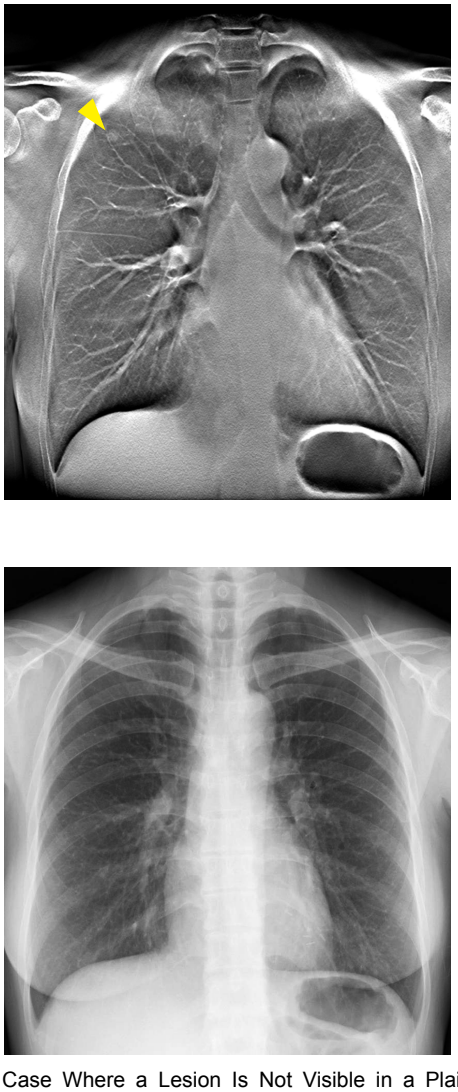

Fig. 1 Case Where a Lesion Is Not Visible in a Plain Chest Radiograph but Is Visible Using Tomosynthesis
(a) Tomosynthesis **(b)** Plain Chest Radiograph

Aim

To investigate the chest tomosynthesis radiography conditions to reduce the X-ray exposure dose while retaining the original lesion visibility

Method

We attempted to reduce the X-ray exposure dose by increasing the analog gain (AG) of the amplifier that amplifies the signals output from the flat panel detector (FPD). The gain was set to the original conditions: AG ×3, ×10, ×20, and ×30. The corresponding radiography conditions that achieve constant output digital values from the FPD were determined to establish the optimum conditions. The noise power spectrum (NPS) was measured at the optimum conditions. The absorbed dose was measured using a chest phantom and the visibility of the simulated nodules and images of volunteers were evaluated. **Table 1** shows the optimal conditions and the measured absorbed dose at each AG.

Gain (AG)	kV	mA	msec	mAs	Surface Absorbed Dose (mGy)
×3 (original)	120	160	3.2	0.51	4.2
×10	120	80	1.6	0.13	1.5
×20	120	25	1.6	0.04	0.71
×30	120	10	1.4	0.014	0.55

Table 1 Optimal Conditions and Measured Absorbed Dose at each AG

Results

Increasing the AG permits lower-dose radiography and reduced absorbed dose. However, radiography at excessively low exposure dose encourages poor graininess and a poor noise power spectrum (NPS) **(Fig. 2)**. Visual evaluation of the simulated nodules and images of volunteers achieved results equivalent to low-dose radiography from AG3 to AG20 **(Fig. 3 and 4)**.

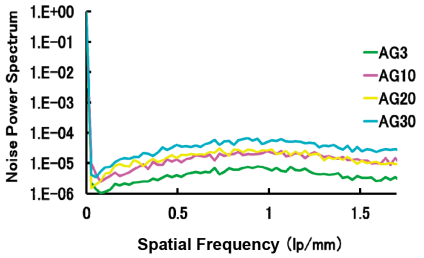

Fig. 2 Noise Power Spectrum at Each AG

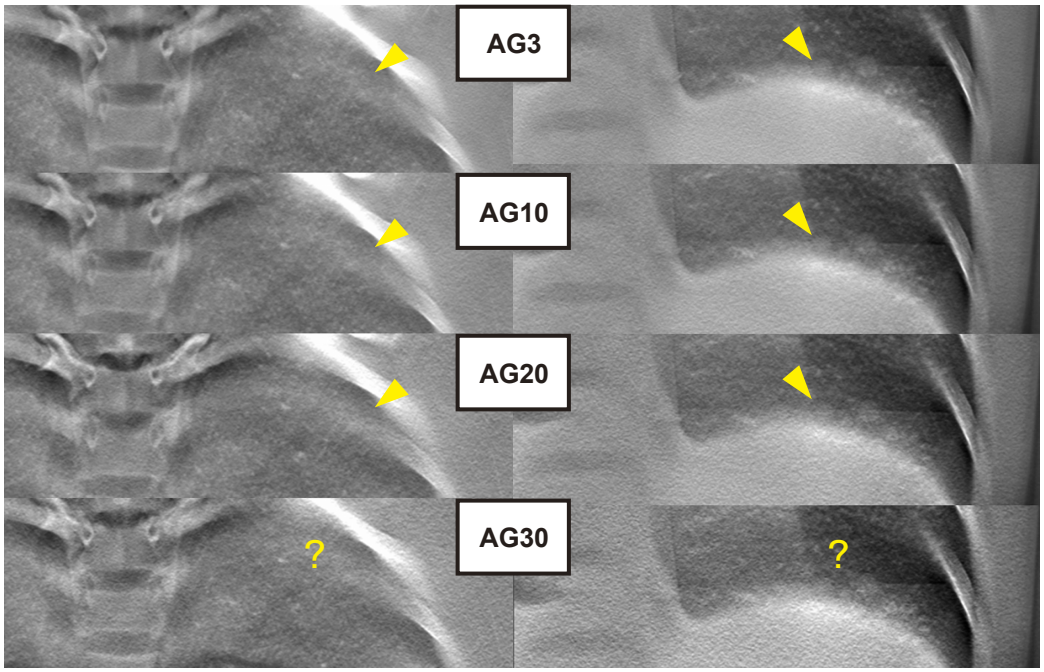

Fig. 3 Visibility of Simulated Nodules in a Chest Phantom at Different AG Values

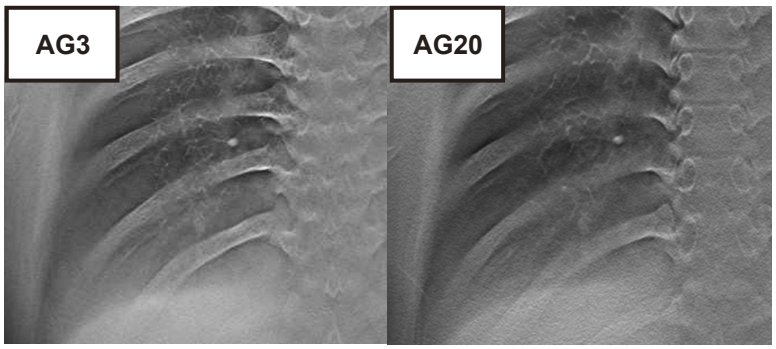

Fig. 4 Visual Evaluation of Images of Volunteers

Discussion

The high AG of the flat panel detector maintains the conventional lesion visibility, while permitting a reduction in the X-ray exposure dose. In this investigation, the exposure dose for chest tomosynthesis was reduced to one-sixth the conventional value, which is approximately 2.4 times the exposure dose of a plain chest radiography. Therefore, we believe chest tomosynthesis to be extremely effective for the screening of healthy patients.