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Masami Ito, MD of the National Cancer Center Hospital East gave a presentation on the Shimadzu SONIALVISION safire R/F System with direct-conversion FPD at the 50th Annual Meeting of the Japan Lung Cancer Society (12/13 November 2009), entitled "The Clinical Utility of Tomosynthesis in Lung Cancer Diagnosis." The contents of her presentation are introduced below.

The Clinical Utility of Tomosynthesis in Lung Cancer Diagnosis

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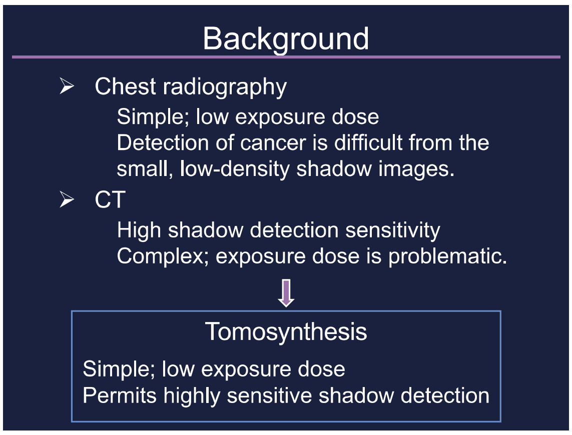
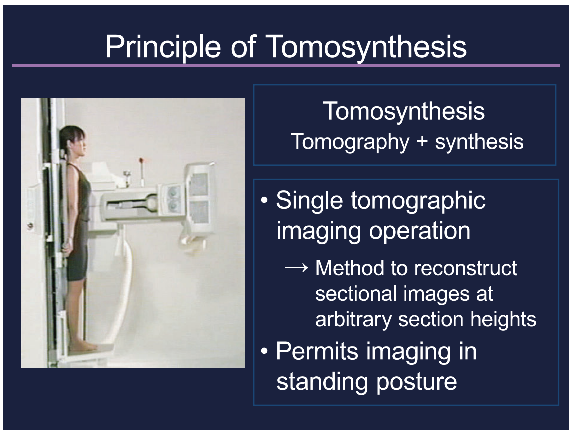
1. Background

The number of fatalities due to lung cancer is increasing. Therefore, the rapid detection of lung cancer through screening is extremely important.
The chest radiography conventionally used for screening has the benefit of convenience and low exposure dose, but detection of cancer is difficult from the small, low-density shadow images.
The introduction of helical CT for screening enhanced the sensitivity of shadow detection and increased the proportion of lung cancers detected early. However, CT with high shadow detection sensitivity can only be introduced into limited facilities and it suffers from problems with high exposure dose.
We focused on a new imaging technology, tomosynthesis. This is a simple technique that offers high shadow detection sensitivity at a low exposure dose.
This paper reports on our investigations into the clinical utility of tomosynthesis in the diagnosis of lung cancer.

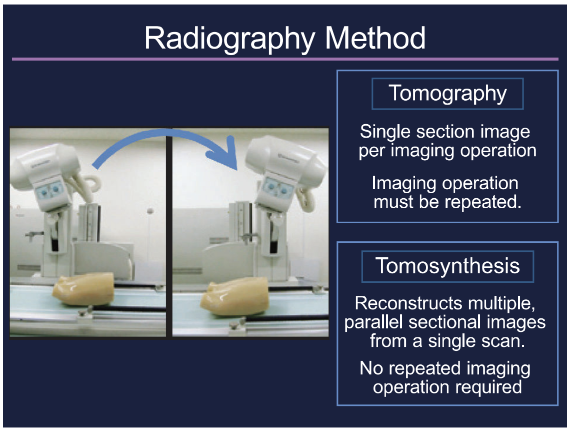


2. Tomosynthesis

The word "tomosynthesis" is a composite of "tomography" and "synthesis." This method can reconstruct a coronal section at an arbitrary height from a single tomographic imaging operation.
The tomography angle and tomography speed can be set, in addition to the radiography conditions, and radiography can be performed in the standing position (standing side-on permits tomography of lateral body sections).

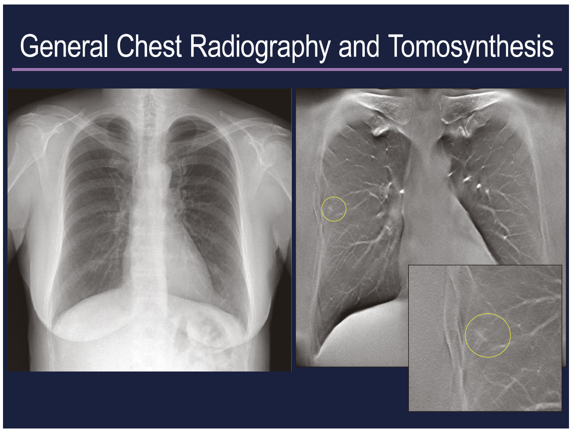


Tomosynthesis involves parallel, planar tomographic scanning with an R/F table system.
Conventional tomography takes only a single section per imaging operation. A long time is required to take the series of images required for diagnosis. It produces images that are difficult to view, due to artifacts known as obstructive shadow.
Conversely, tomosynthesis can reconstruct multiple sectional images from a single scan and offers image processing to reduce artifacts.



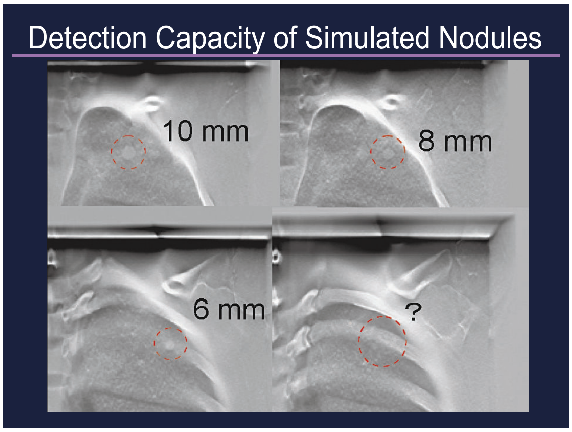
3. Comparison with General Chest Radiography Image

A general chest radiography and tomosynthesis image of the same patient are shown below.
The general chest radiography cannot clearly indicate an abnormality, whereas the tomosynthesis image reveals a nodular shadow in the right mid-lung field.



4. Detection Capacity of Simulated Nodules

We evaluated the nodule detection capacity of tomosynthesis using phantoms with embedded simulated nodules.
The 4 mm nodule in the bottom-right tomosynthesis image is difficult to identify, but the 6 mm, 8 mm, and 10 mm nodules can be identified.



5. Comparison of Exposure Dose

The tomosynthesis exposure dose is discussed below.
The measured exposure dose for the image interpretation tests was 1.2 mGy, but currently a low dose of 0.21 mGy is used for imaging. This is approximately two times the dose for general chest radiography and one-tenth the dose for a CT scan.

Exposure dose

Tomosynthesis:

	kV	mA	msec	Measured Exposure Dose (mGy)
Conditions for Image Interpretation Test	120	160	3.2	1.2
Current	120	25	1.6	0.21

Chest radiography: 0.09 mGy
CT scan conditions: 2.05 mGy

6. Comparative Image Interpretation Test with General Chest Radiography

As described above, tomosynthesis is a simple method that offers high shadow detection sensitivity at a low exposure dose.
We performed image interpretation tests on chest tomosynthesis images to evaluate the detection capacity of small nodules in the lung field.
The subject of the test was 52 nodules in images of 24 clinical patients and 14 normal subjects taken between the end of 2008 and March 2009.
Tomosynthesis images were taken first, followed by general chest radiography images. They were interpreted by four technologists, two each from the Respiratory Disease Division and the Radiology Division.
One each from both divisions evaluated the tomosynthesis image followed by the general chest radiography; the other two evaluated the images in the reverse order.
The interpretation test was conducted to determine the existence of nodules in the lung field, excluding linear shadows and bone lesions.
The images were interpreted using CT images as the gold standard.

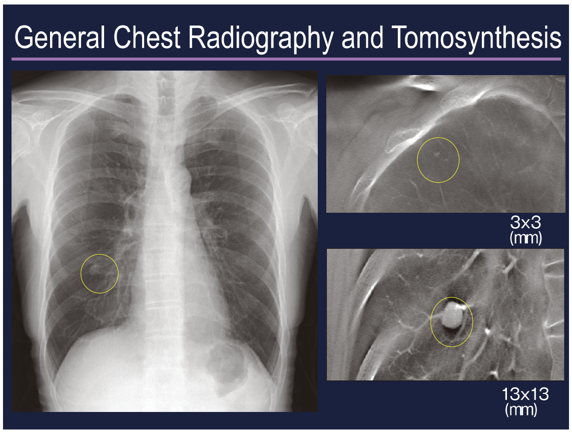
Interpretation Test for General Chest Radiography and Tomosynthesis

- Aim
  To evaluate the detection capacity of chest tomosynthesis for small nodules in the lung field
- Subject Images
  52 nodules in images of 24 clinical patients and 14 normal subjects taken between the end of 2008 and March 2009
- Method
  Tomosynthesis images followed by general chest radiography images
  Interpretation by two each from the Respiratory Disease Division and the Radiology Division
  Evaluation of the sensitivity and specificity for diagnosis of the existence of nodules in the lung field

Examples of images are shown below.

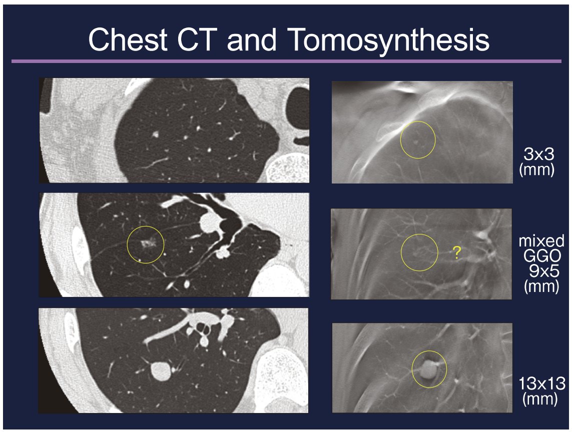
A nodule can be confirmed in the right-lower lung field of the general chest radiography image. No other nodule is apparent.

Conversely, tomosynthesis confirmed an approximately 3 mm nodule at the pulmonary apex, in addition to the nodule in the right-lower lung field.



Chest CT images are shown below for the same case.

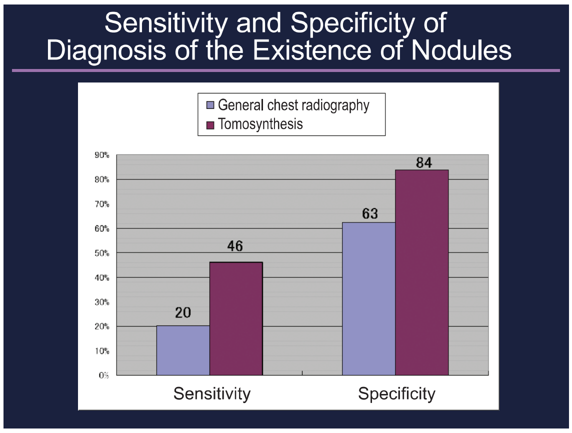
In addition to the two nodules described above, chest CT confirmed a mixed GGO in right S6 that was difficult to identify by tomosynthesis.



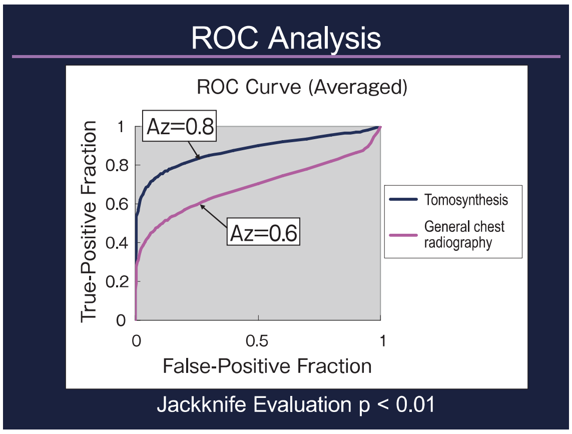
7. Results of Interpretation Tests

The sensitivity and specificity for diagnosis of the existence of nodules by tomosynthesis obtained from the interpretation tests are described below.

Chest radiography achieves 20 % sensitivity and 63 % specificity. Tomosynthesis achieves 46 % sensitivity and 84 % specificity. Therefore, tomosynthesis is superior in terms of both sensitivity and specificity.



ROC analysis was performed on the diagnostic capacity of chest radiography and tomosynthesis. The Az values were 0.6 for chest radiography and 0.8 for tomosynthesis. Evaluation by the jackknife method indicated that tomosynthesis achieves significantly higher diagnostic capacity for nodules.



8. Conclusions

Tomosynthesis offers higher detection capacity for nodules in the lung field than general chest radiography images, and could be applied to general clinical and lung-cancer screening applications.