

# Can the overlooked lung cancer be detected by the BS / TS algorithm ?



Hiroshi Moriya MD. PhD.1, Motoharu. Hakozaiki MD2, Yukiko Kumasaka MD. PhD.1,

1 Image Diagnosis Center, Ohara General Hospital, Fukushima, Japan

2 Department of Radiology, Fukushima Medical University, Fukushima, Japan



# Purpose

In the Mayo Lung Project, a retrospective study reported that 90% of lung cancer cases were visible in past chest roentgenogram for months or even years. Thus, the purpose of this study is to evaluate the added value of bone-suppression algorithm (BS) and temporal-subtraction algorithm (TS) on the detection and diagnostic confidence of early lung cancers in the roentgenogram which the specialist overlooked. (Fig.1)

# Materials and methods

ClearRead Xray (Bone Suppress and Compare: Riverain Technologies) were used.

Pathologically confirmed 36 lung cancers. All cases examined chest roentgenogram annually. The roentgenogram that could not point out the lesions at that time (1 and 2 years before) were analyzed by BS and TS. Four data sets (Chest roentgenogram only, CR+BS, CR+TS, CR+BS+TS) were prepared for this evaluation.

Two radiologists visually graded the diagnostic confidence on a 5-point scale from 1 (definitely absent) to 5 (definitely present). The value of these algorithm were assessed in a receiver-operating characteristic curve analysis.

Radiologist A: Resident with few opportunities to diagnose chest roentgenogram.

Radiologist B: Chest radiologist with many opportunities to diagnose chest roentgenogram.

# Results

Radiologist A: The number of true positive was 1 in the Data set A, 6 in the Data set B, 14 in the Data set C and 12 in the Data set D. AUC (area under the curve) of ROC was 0.52 for Data set A, 0.64 for Data set B, 0.81 for Data set C and 0.77 for Data set D.

Radiologist B: The number of true positive was 16 in Data set A, 16 in Data set B, 20 in Data set C and 20 in Data set D. AUC of ROC was 0.86 for Data set A, 0.86 for Data set B, 0.95 for Data set C and 0.95 for Data set D. (Fig.2)

By using bone-suppression algorithm and temporal-subtraction algorithm, it became possible to detect lung cancer in an earlier stage. This is particularly effective for those who have little experience in image interpretation.

Case presentation of 20 cases that had findings (Fig.3 - Fig.22)

Original chest roentgenogram image, bone-suppression algorithm image (BS) , temporal-subtraction algorithm image (TS) and CT image when lung cancer is detected (approximately one year after the chest roentgenogram) are presented.

# ROC

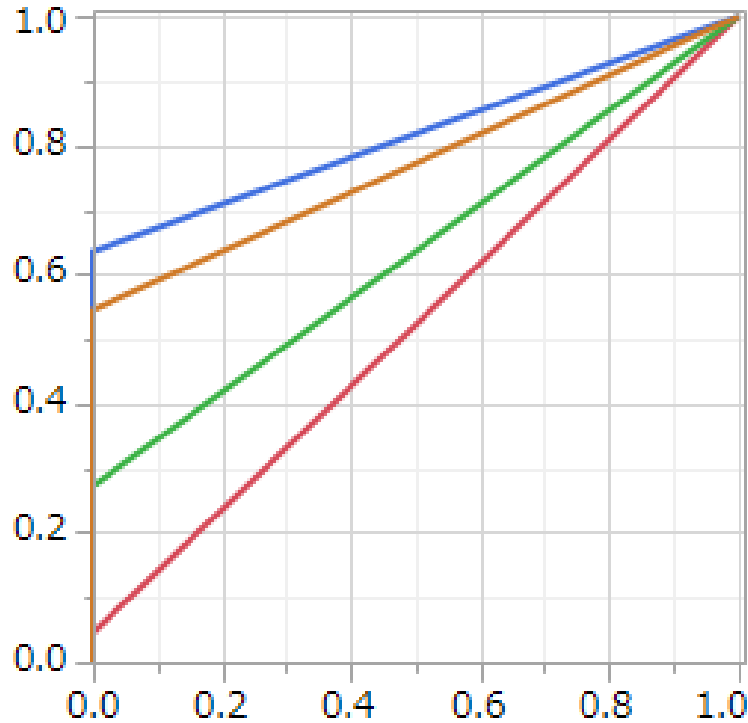
Chest roentgenogram  
only

CR+BS

CR+TS

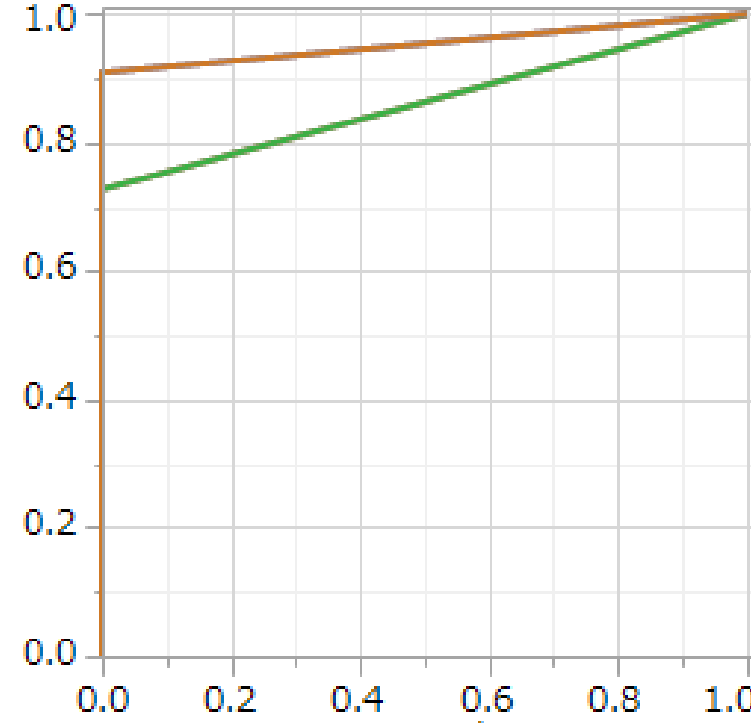
CR+BS+TS

Radiologist A (Resident with few opportunities to diagnose chest roentgenogram)

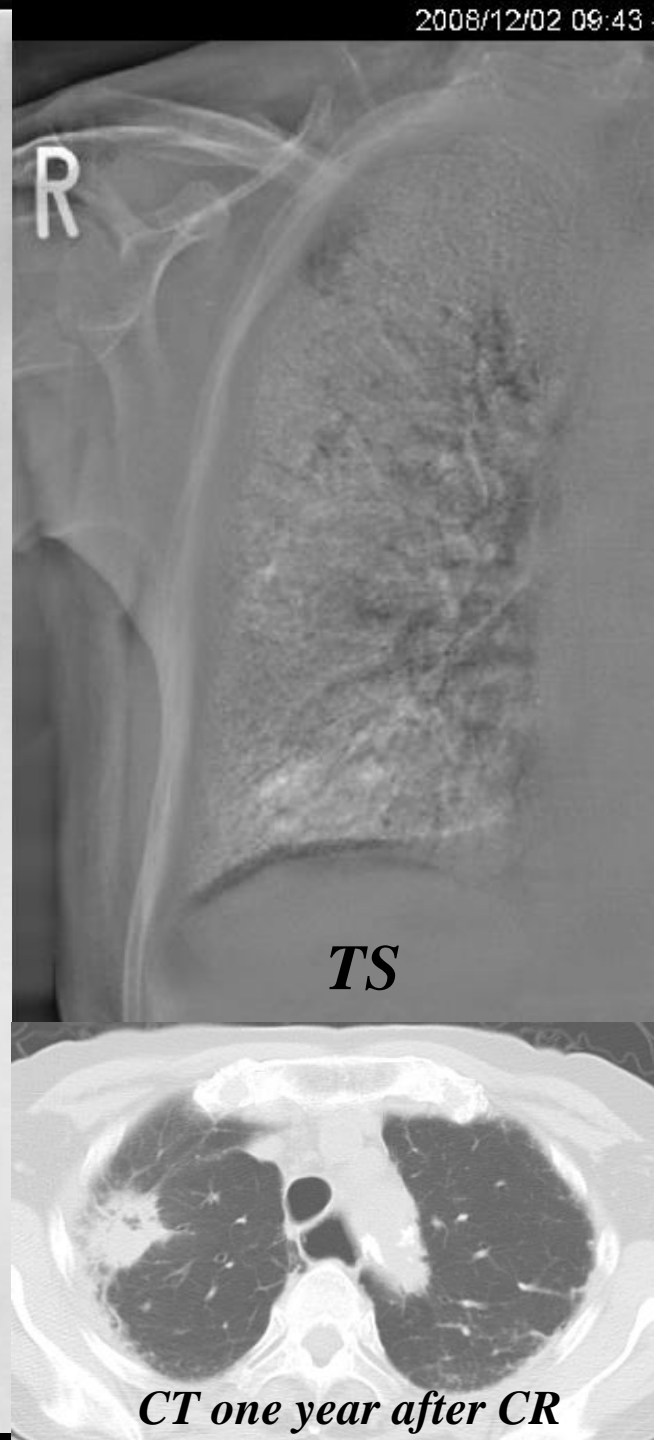
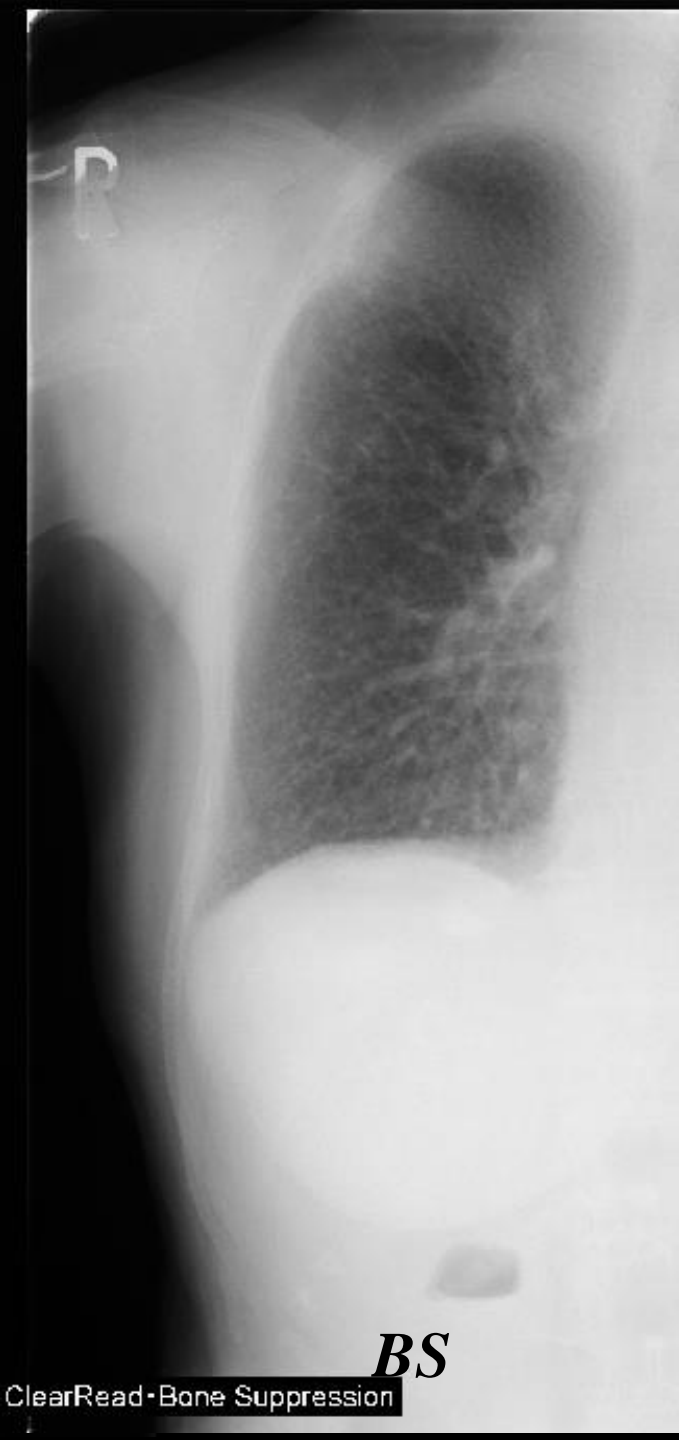
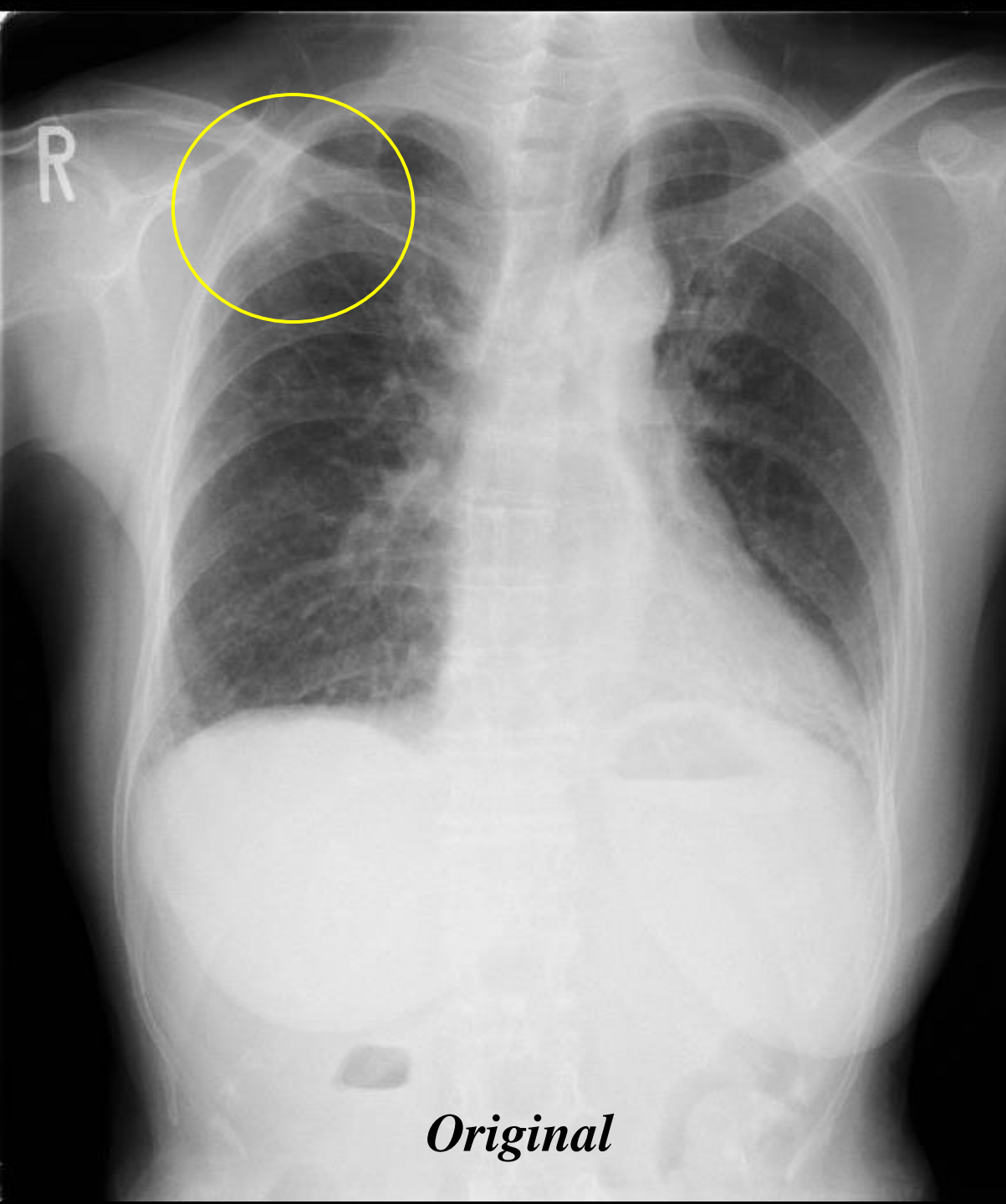


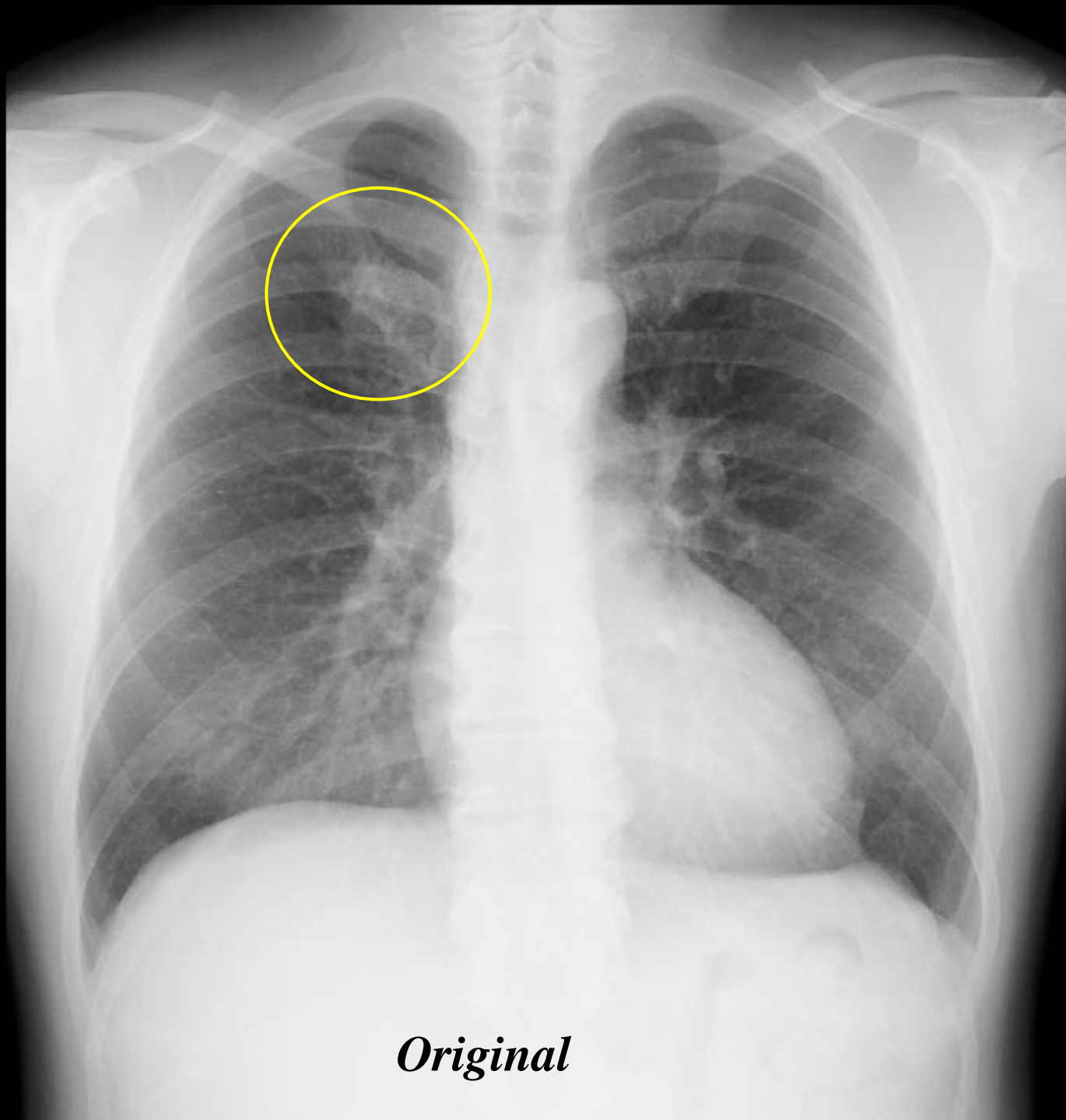
AUC (area under the curve) of ROC  
0.52 for Chest roentgenogram only  
0.64 for CR+BS  
0.81 for CR+TS  
0.77 for CR+BS+TS

Radiologist B (Chest radiologist with many opportunities to diagnose chest roentgenogram)



AUC (area under the curve) of ROC  
0.86 for Chest roentgenogram only  
0.86 for CR+BS  
0.95 for CR+TS  
0.95 for CR+BS+TS



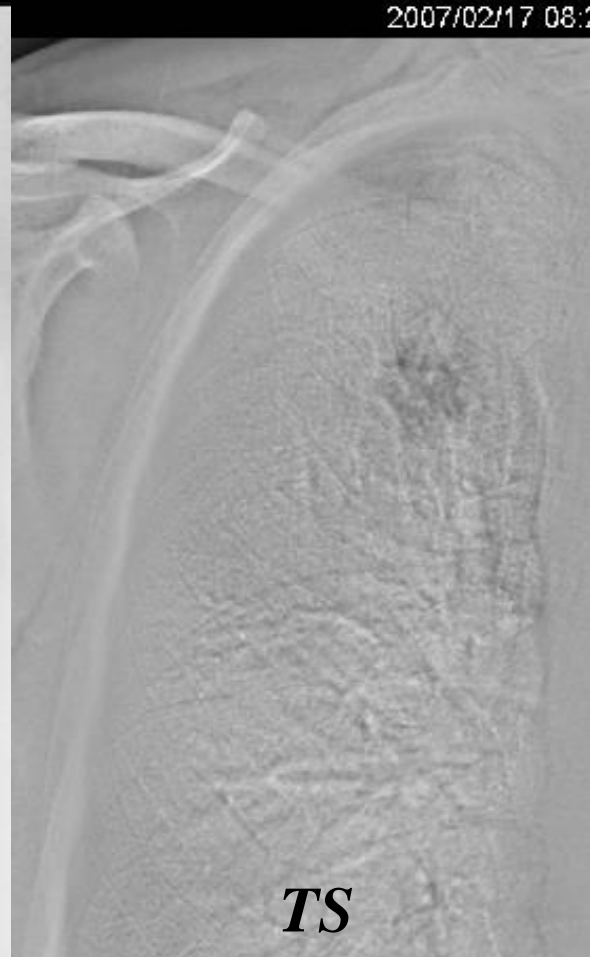


*Original*

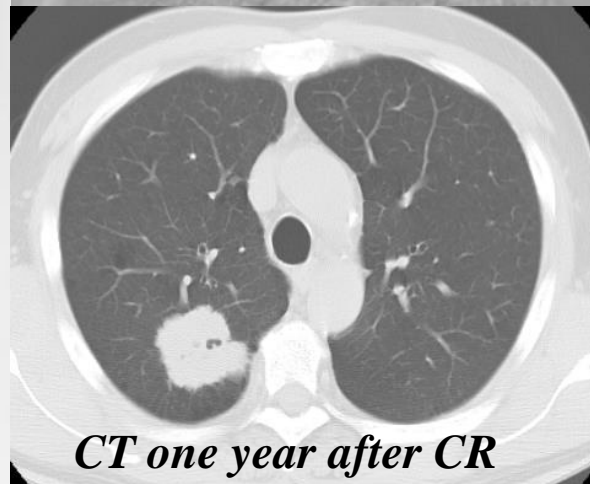


*BS*

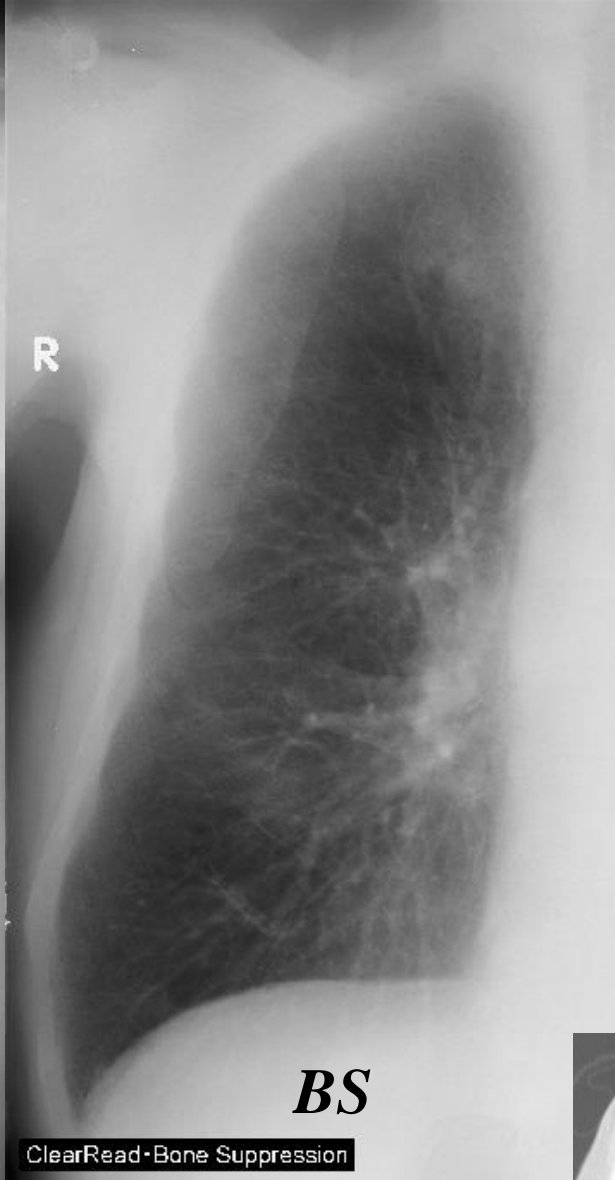
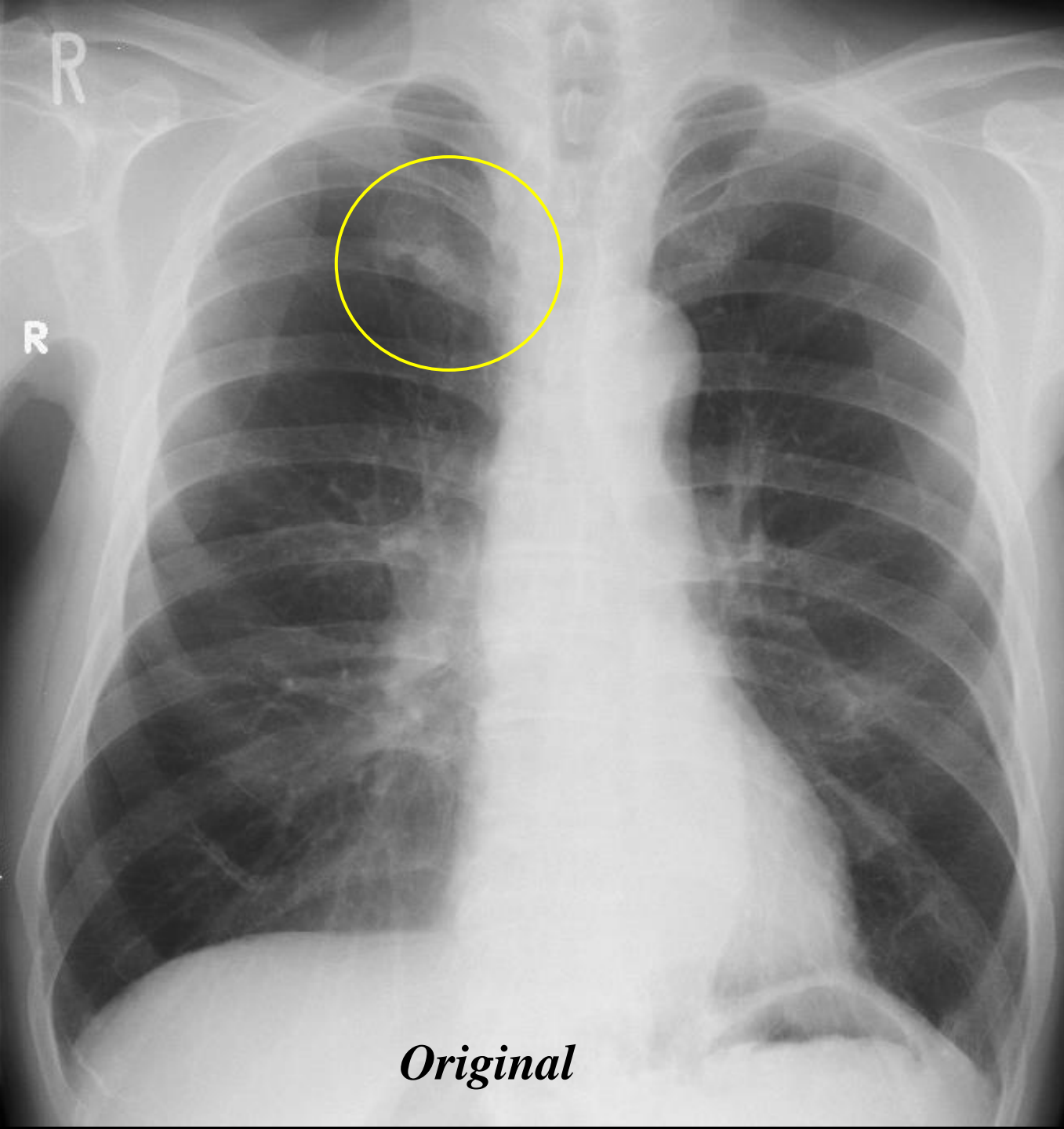
Read-Bone Suppression



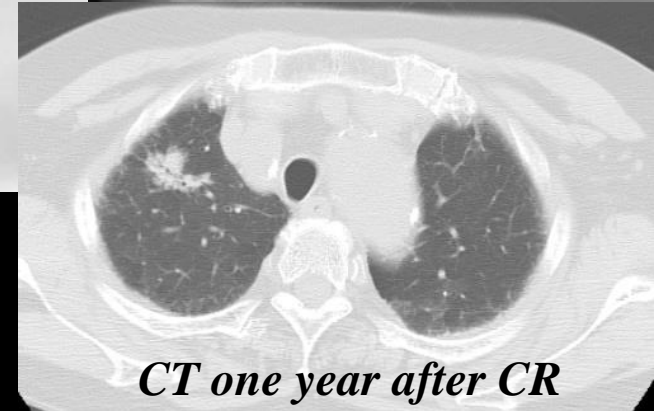
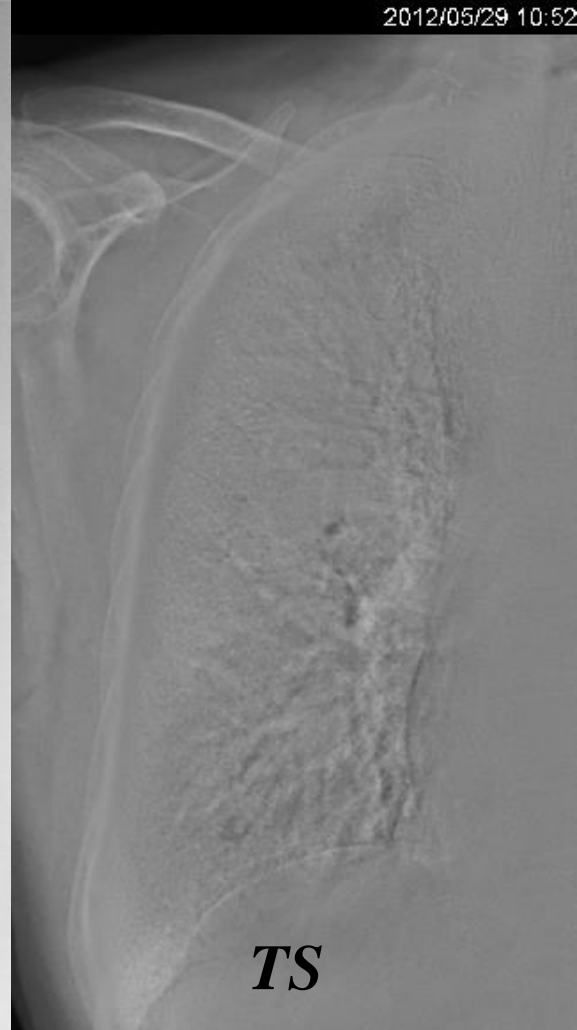
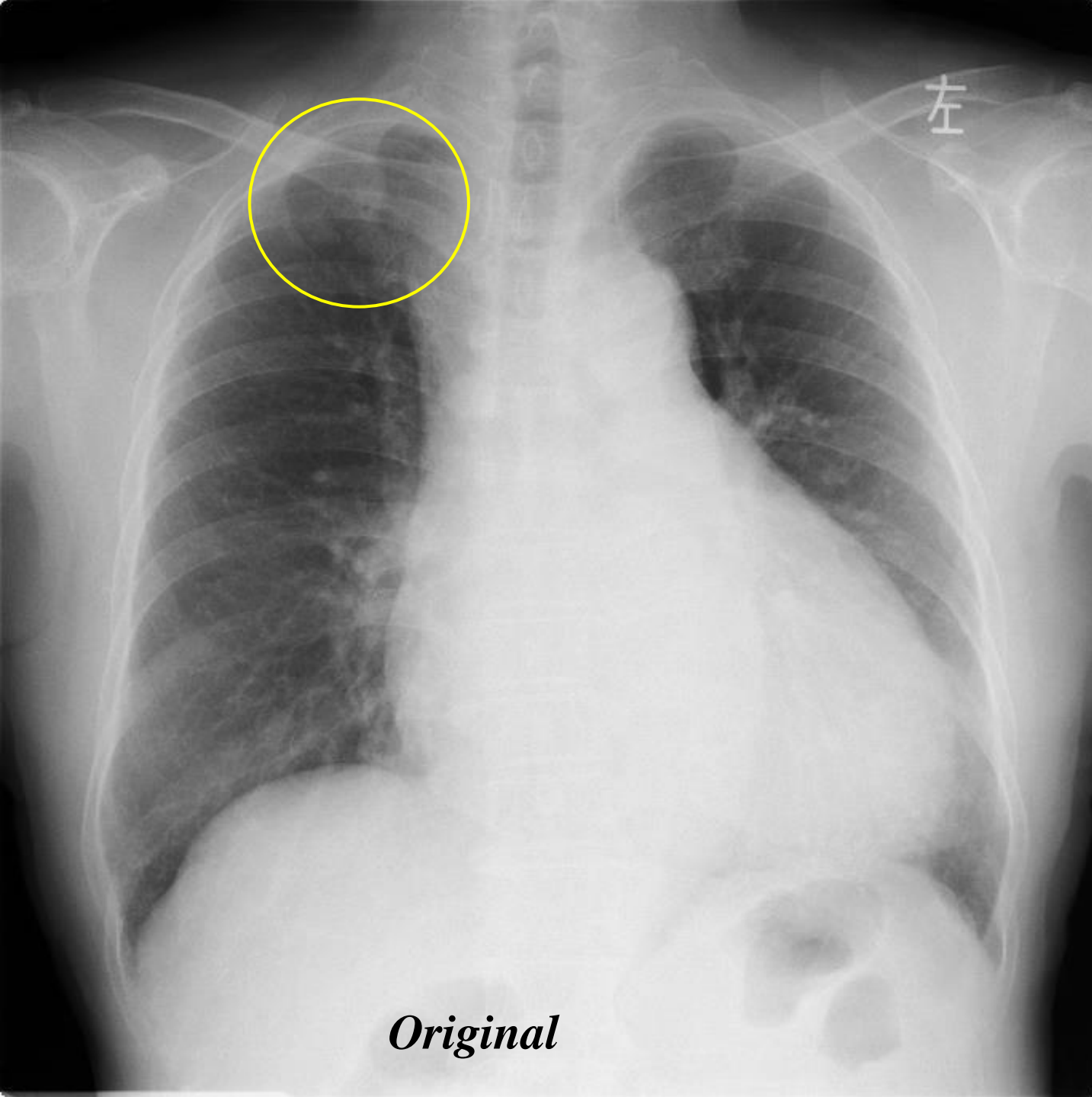
*TS*

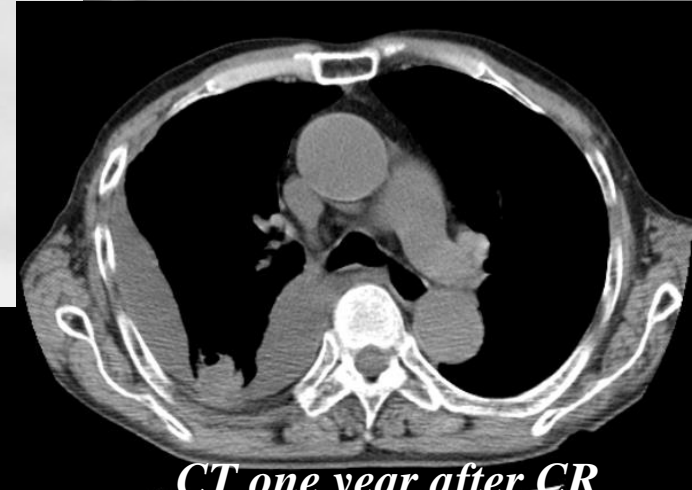
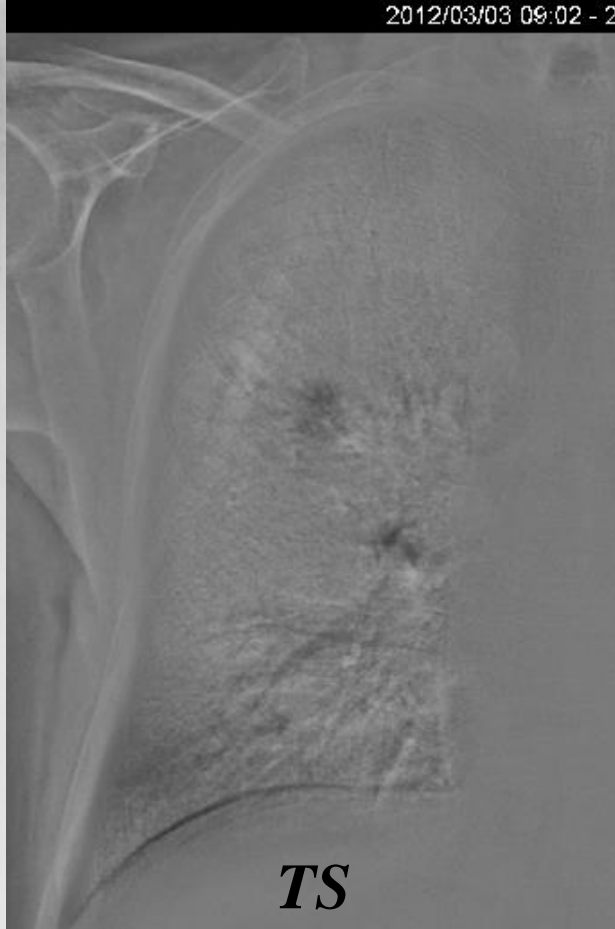
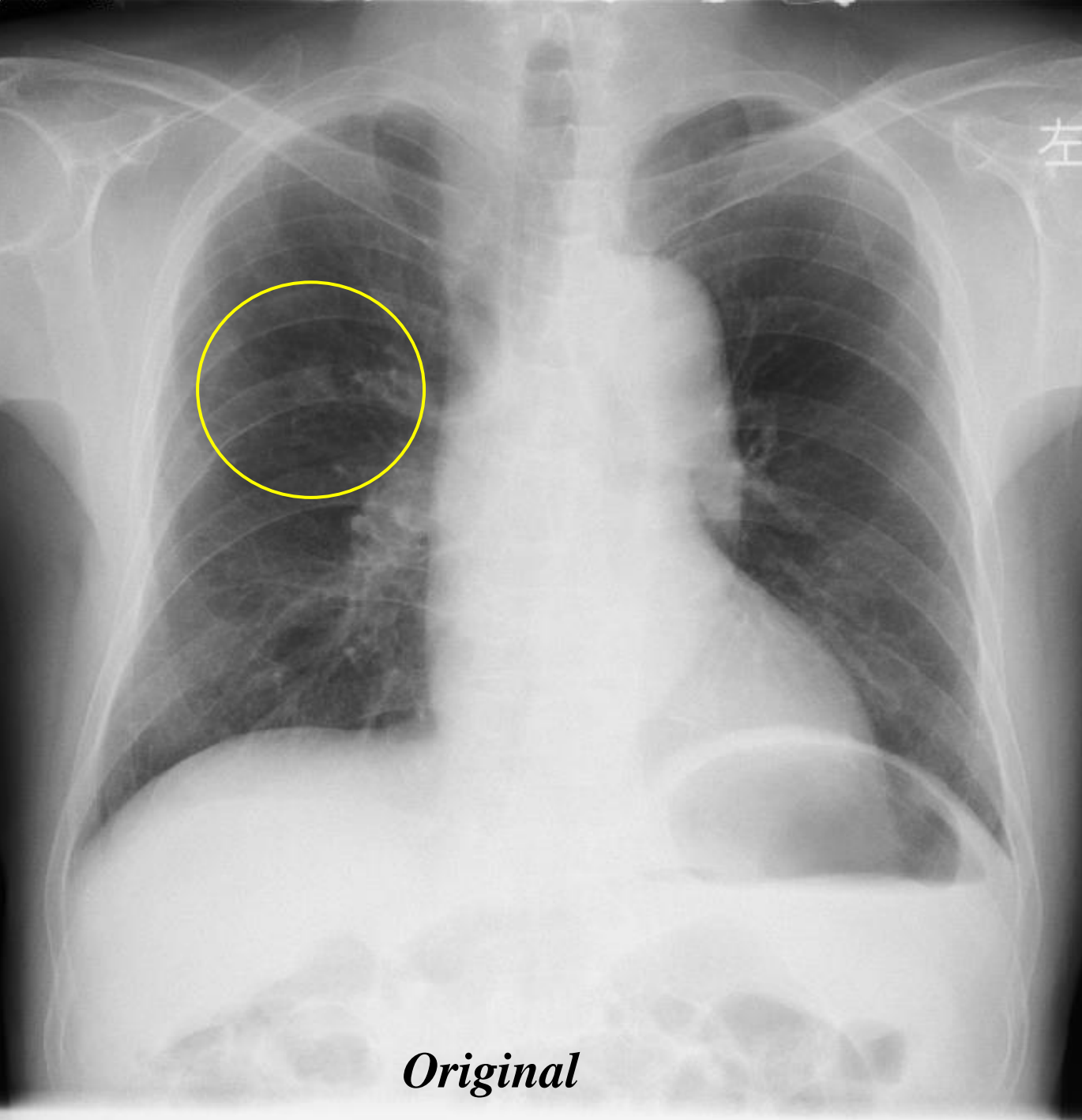


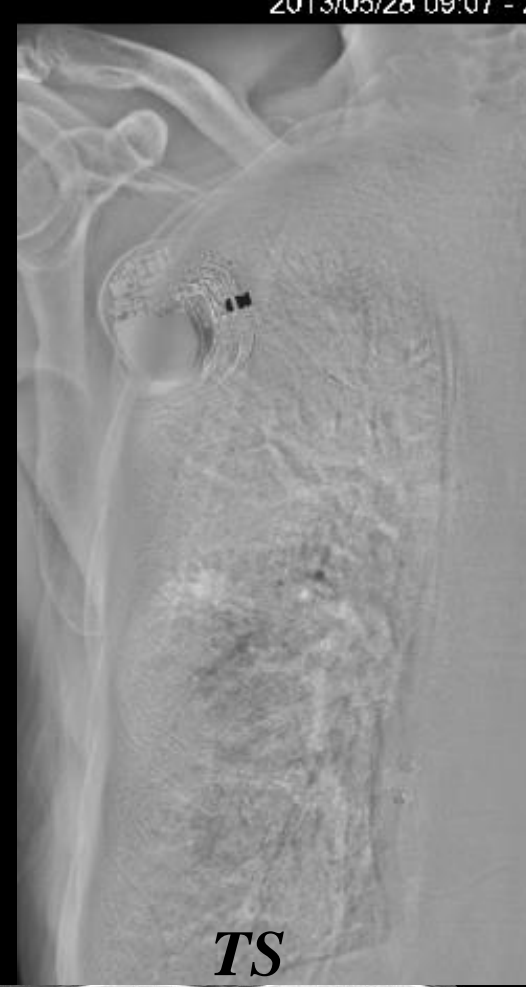
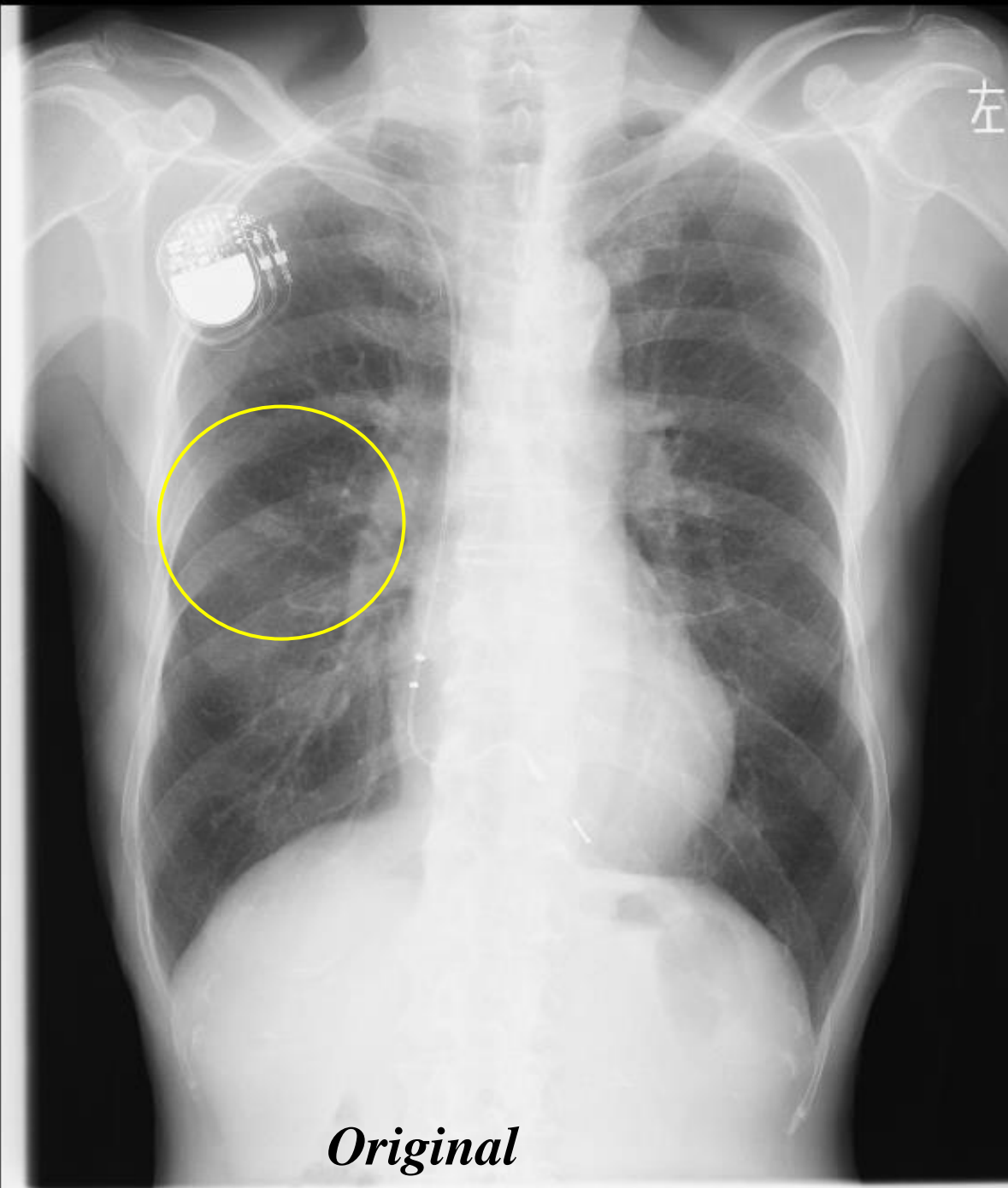
*CT one year after CR*

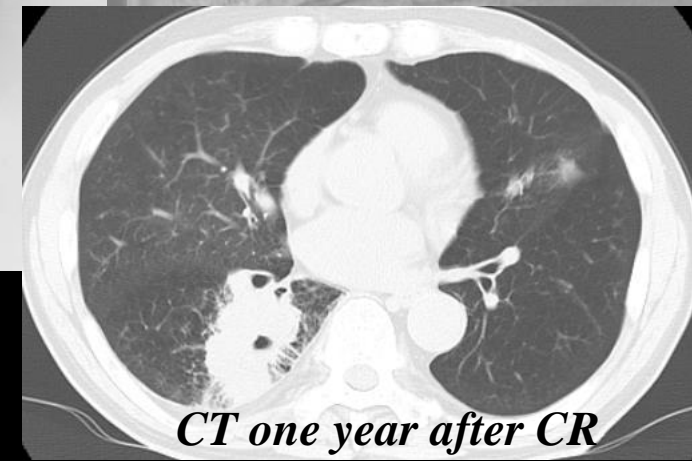
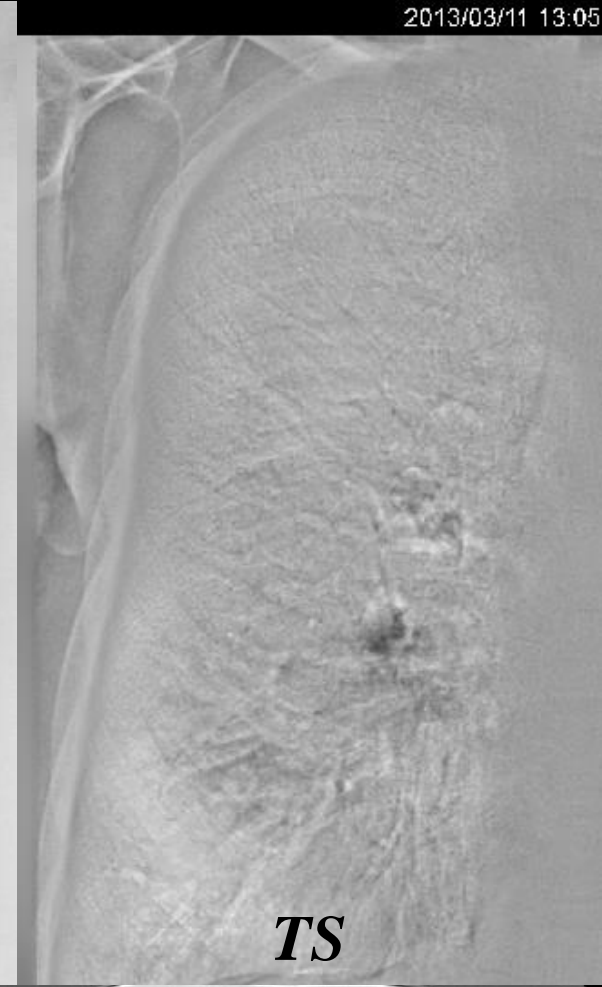
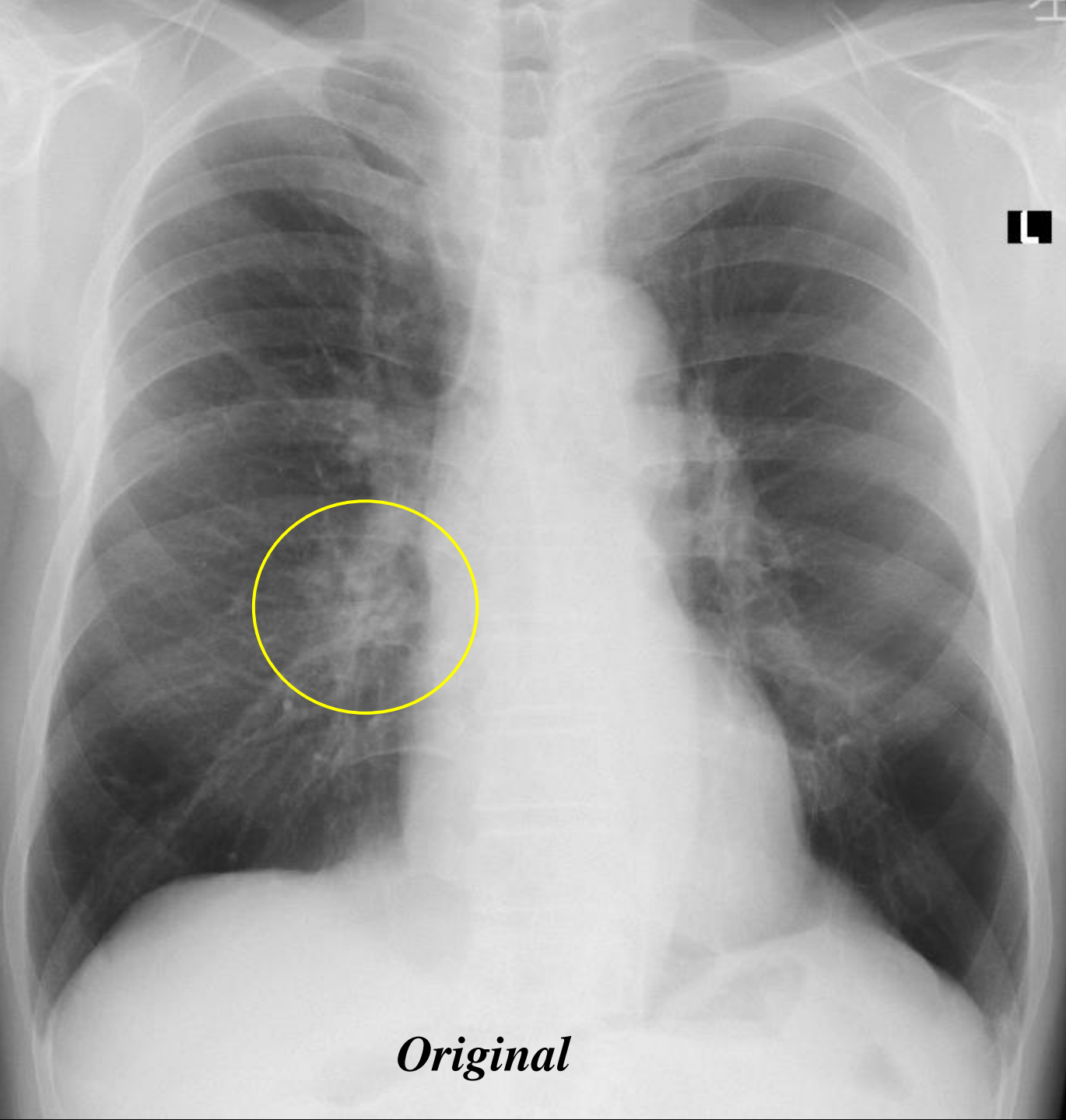


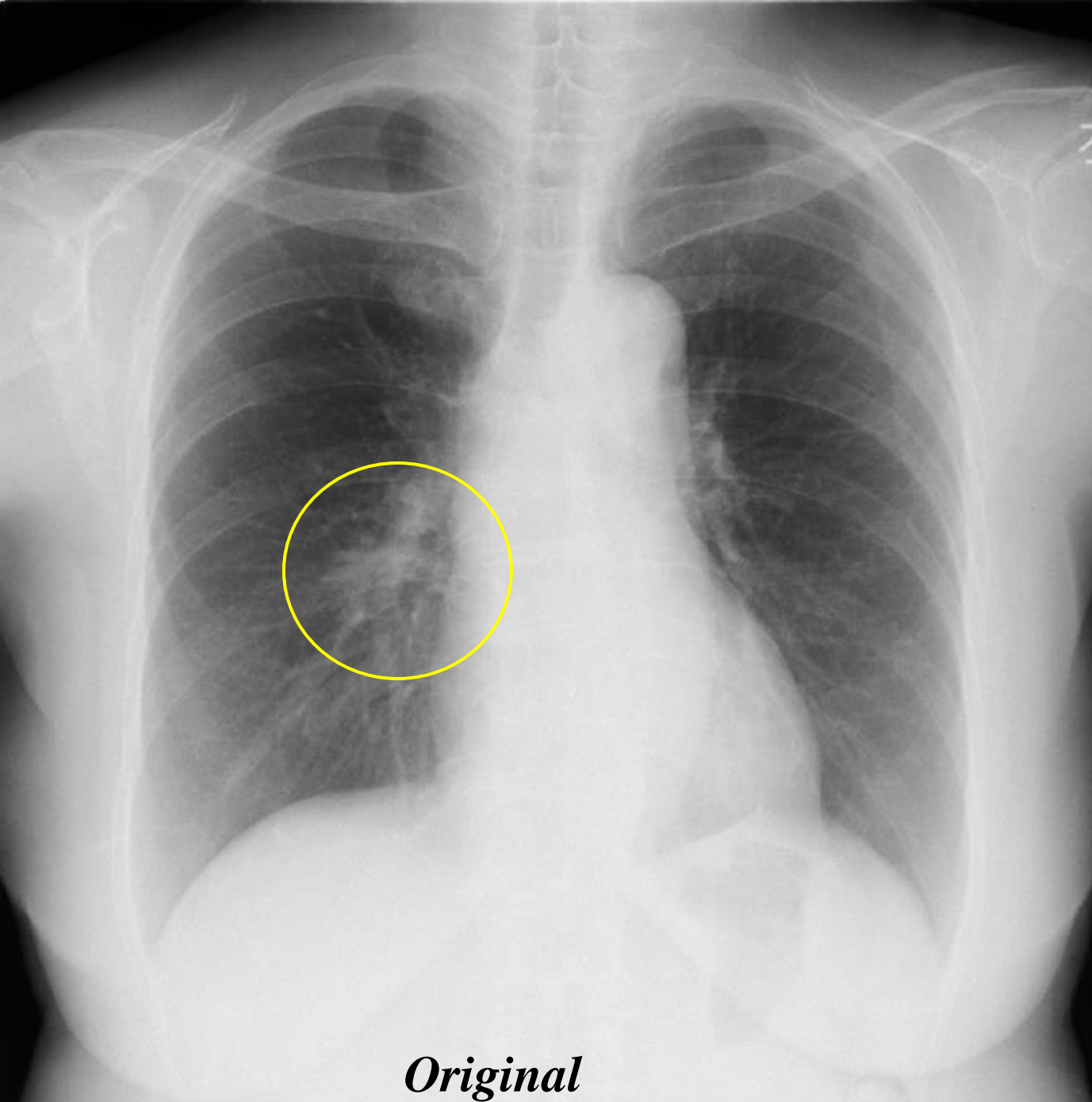




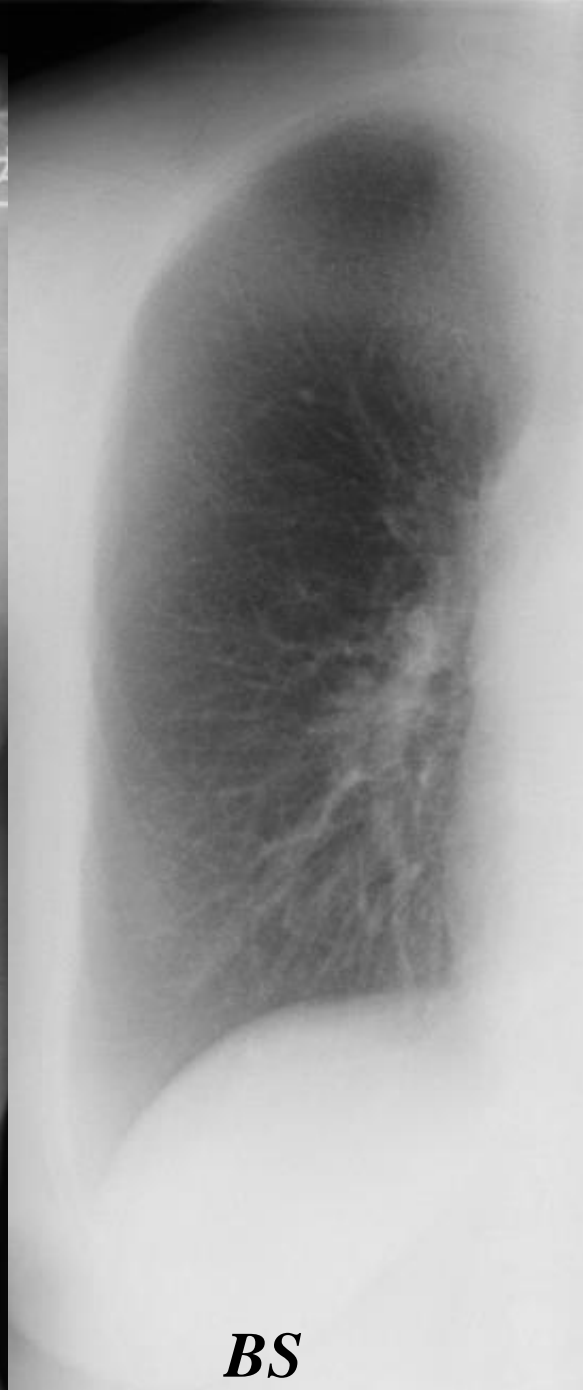






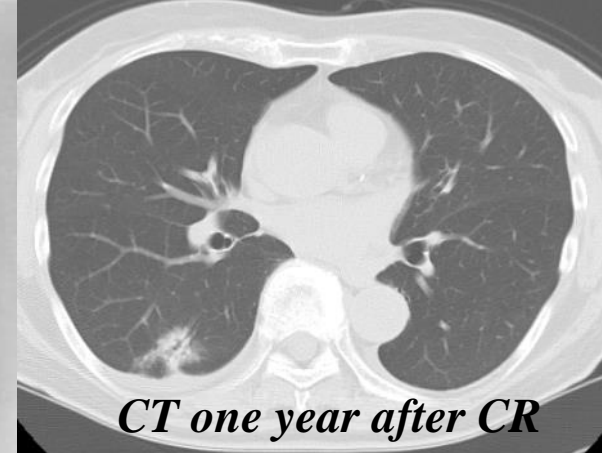


*Original*



*BS*

Lead-Bone Suppression

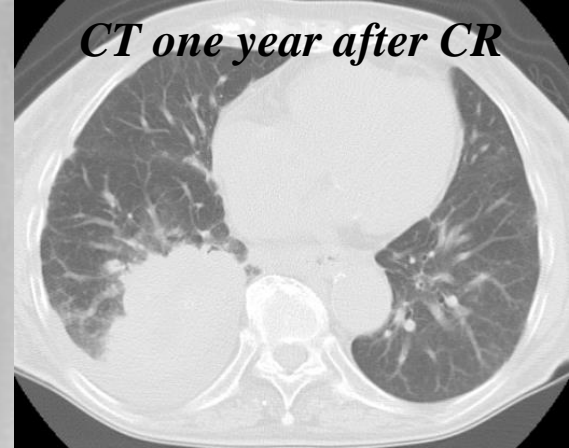
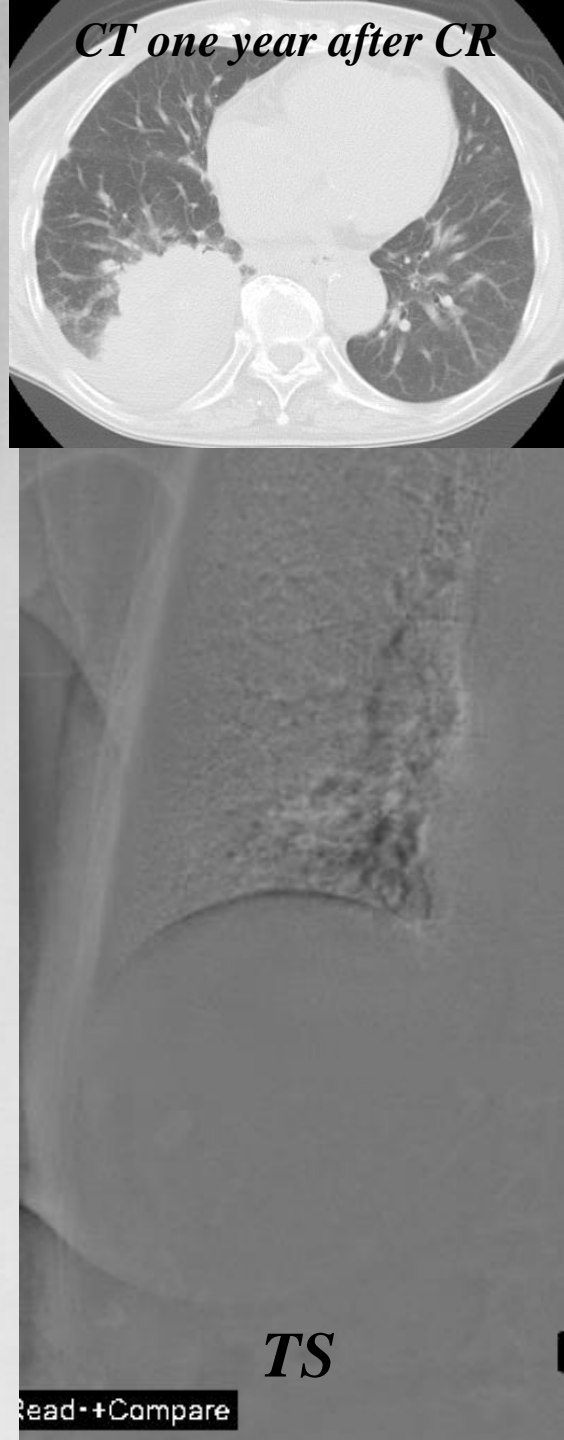
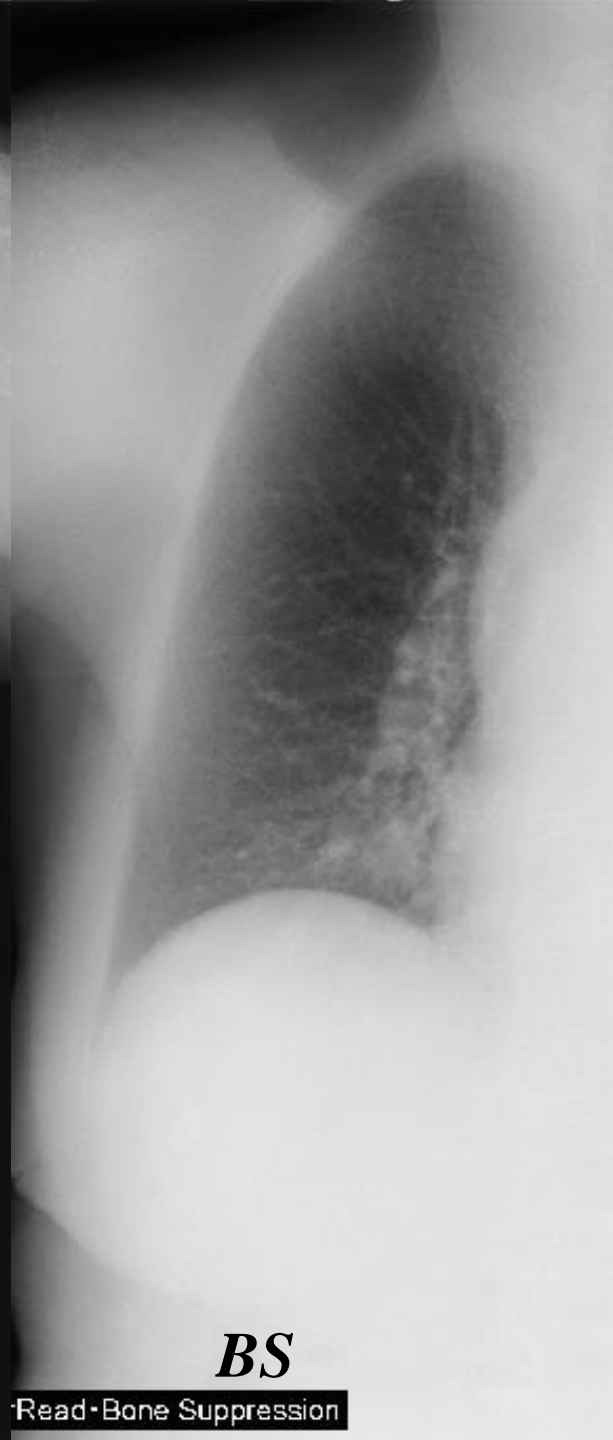
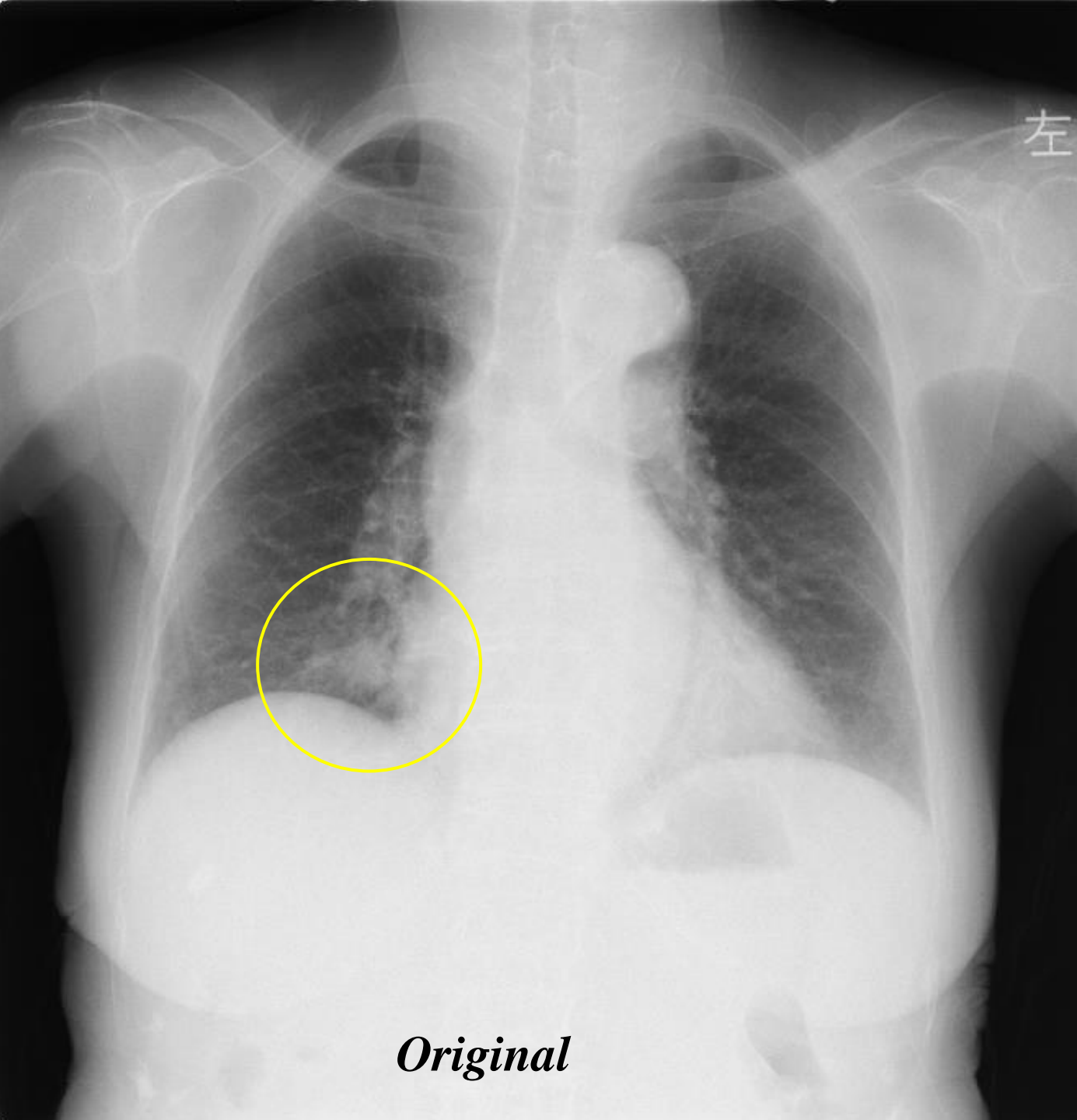


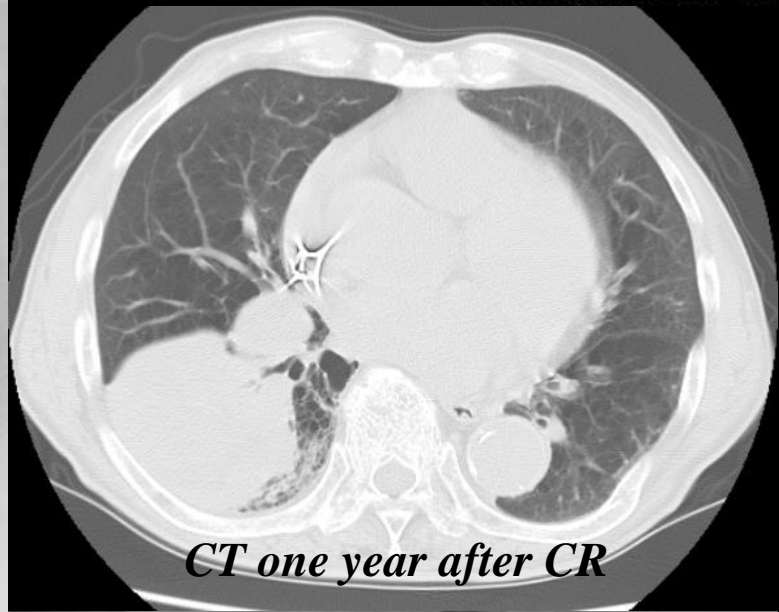
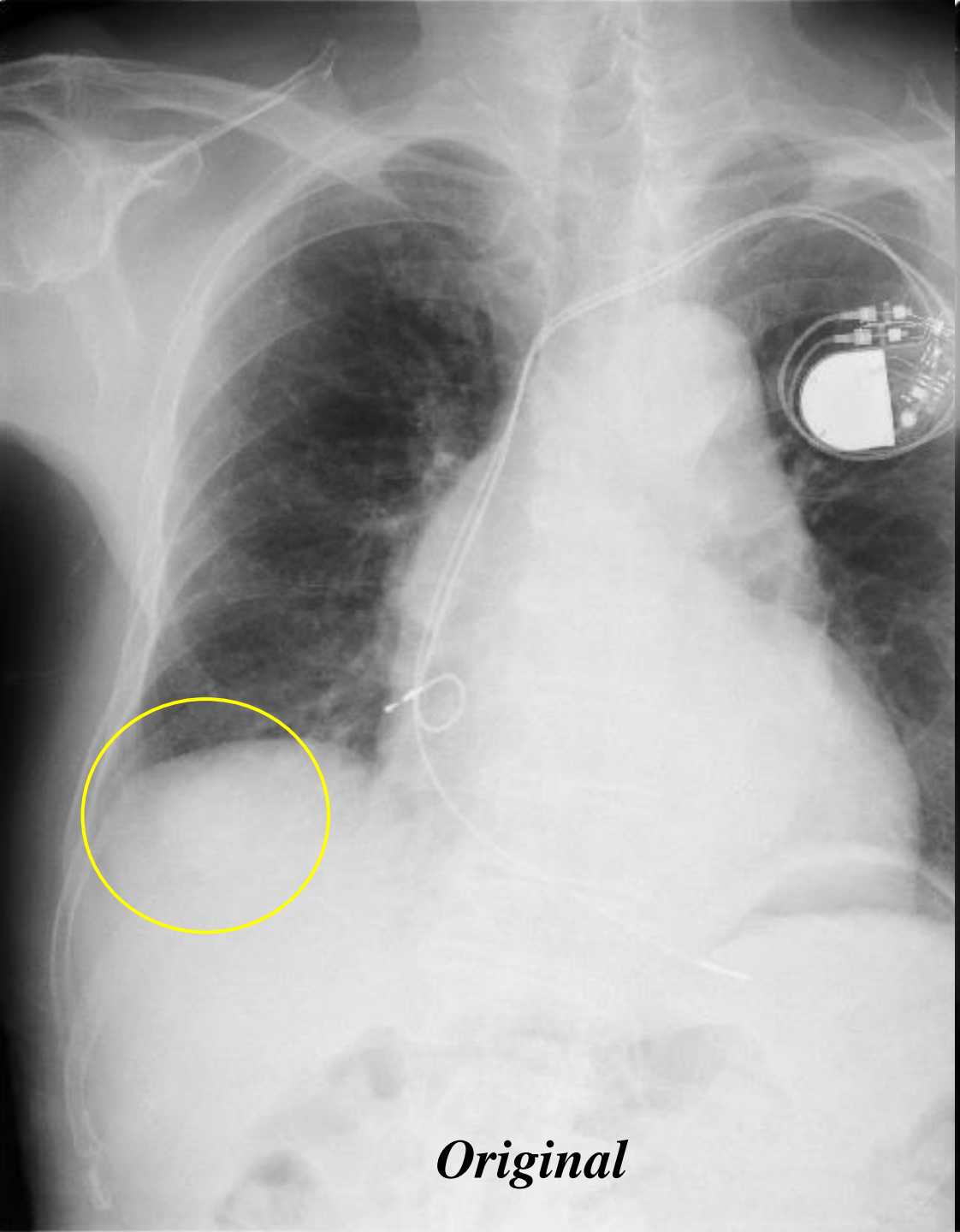
*CT one year after CR*

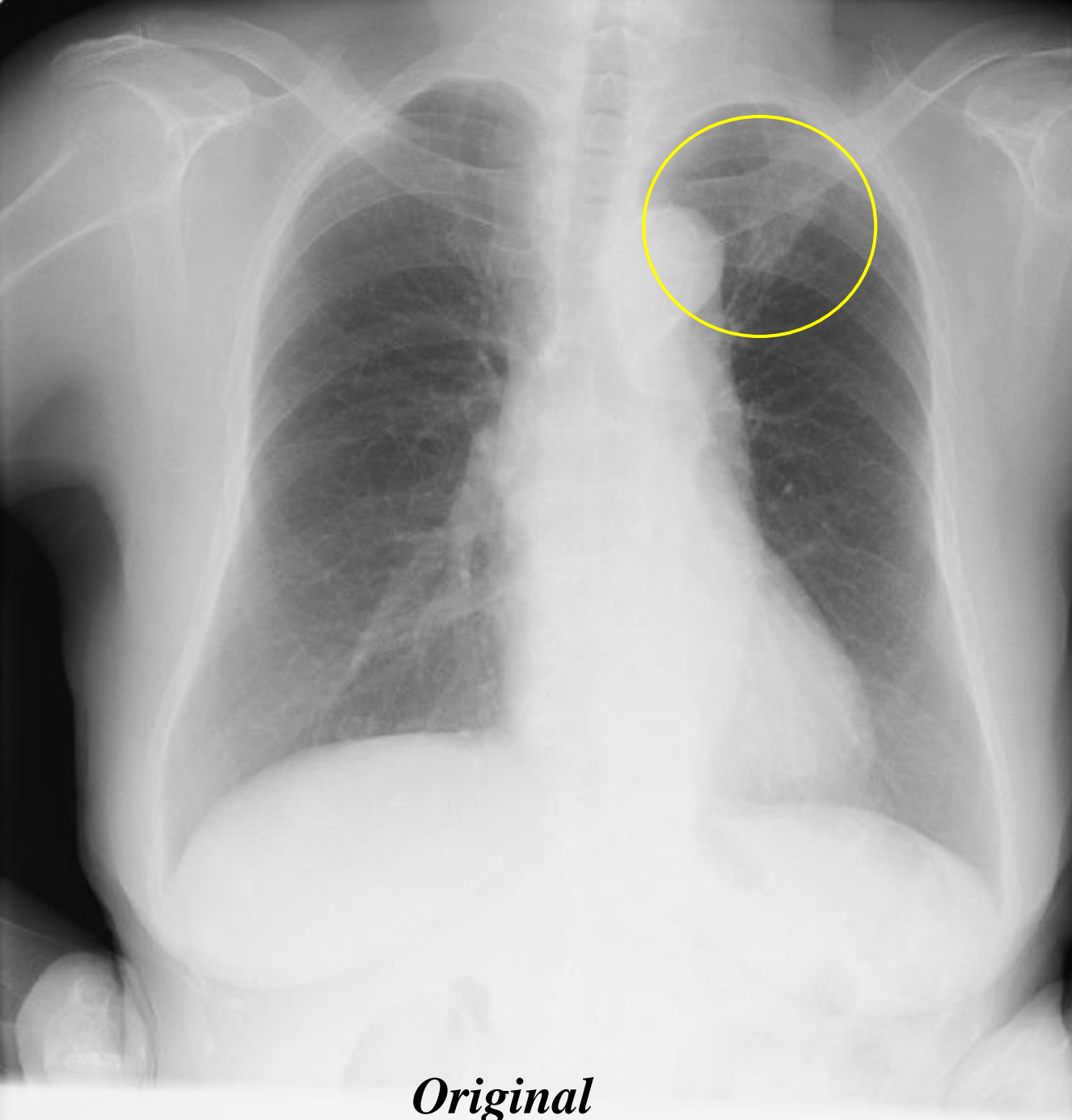


*TS*

Lead-+Compare



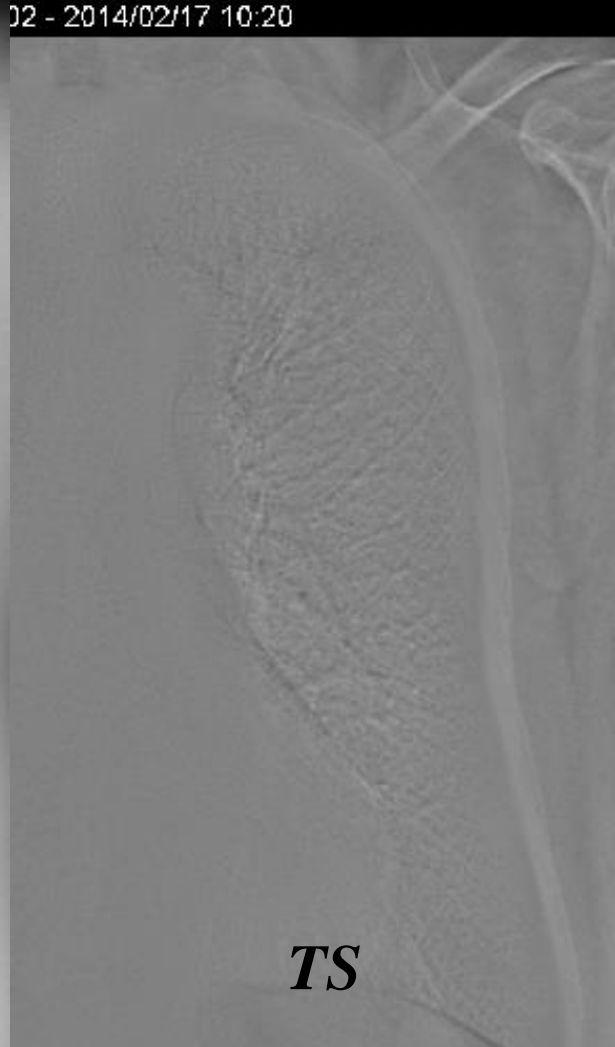




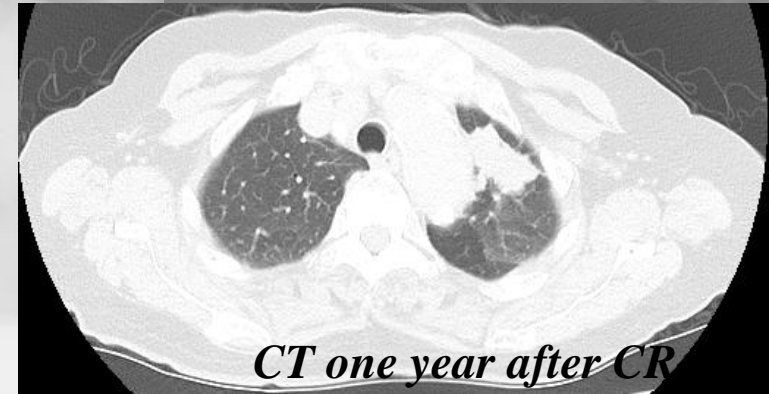
*Original*



*BS*

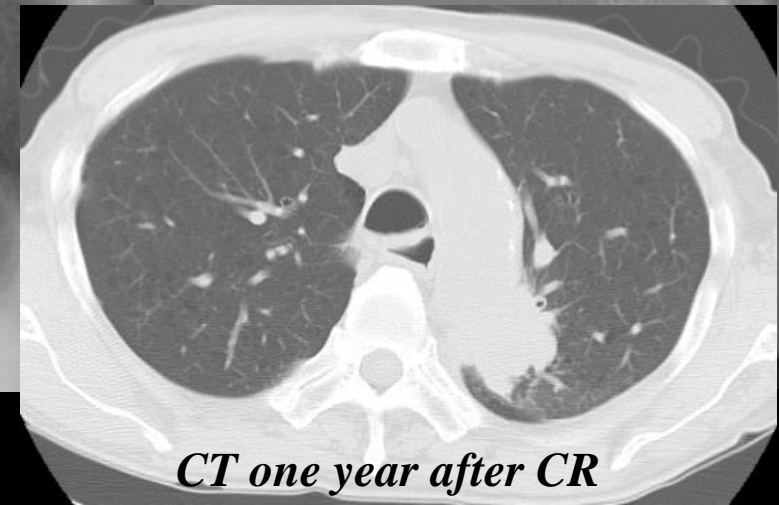
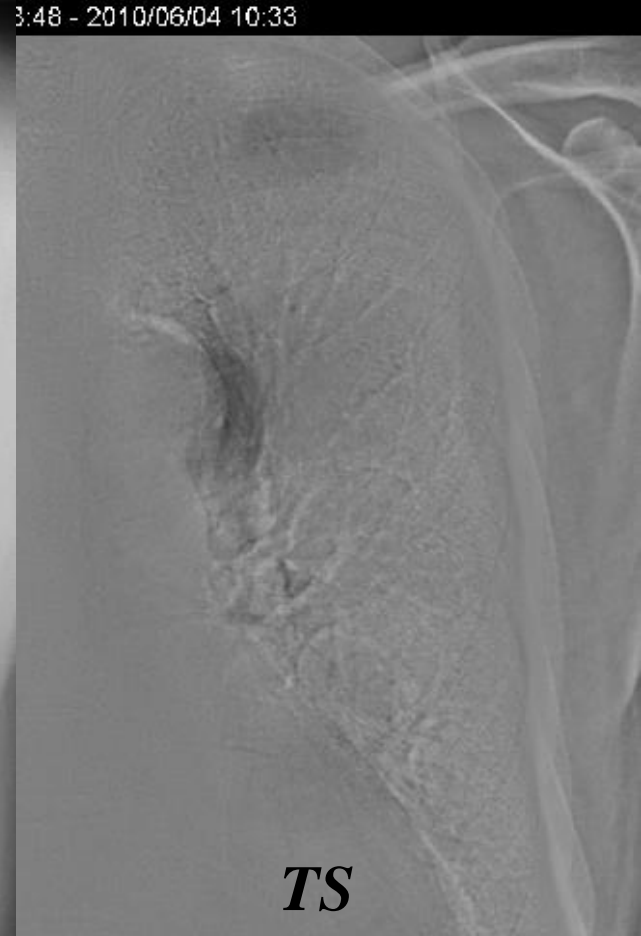
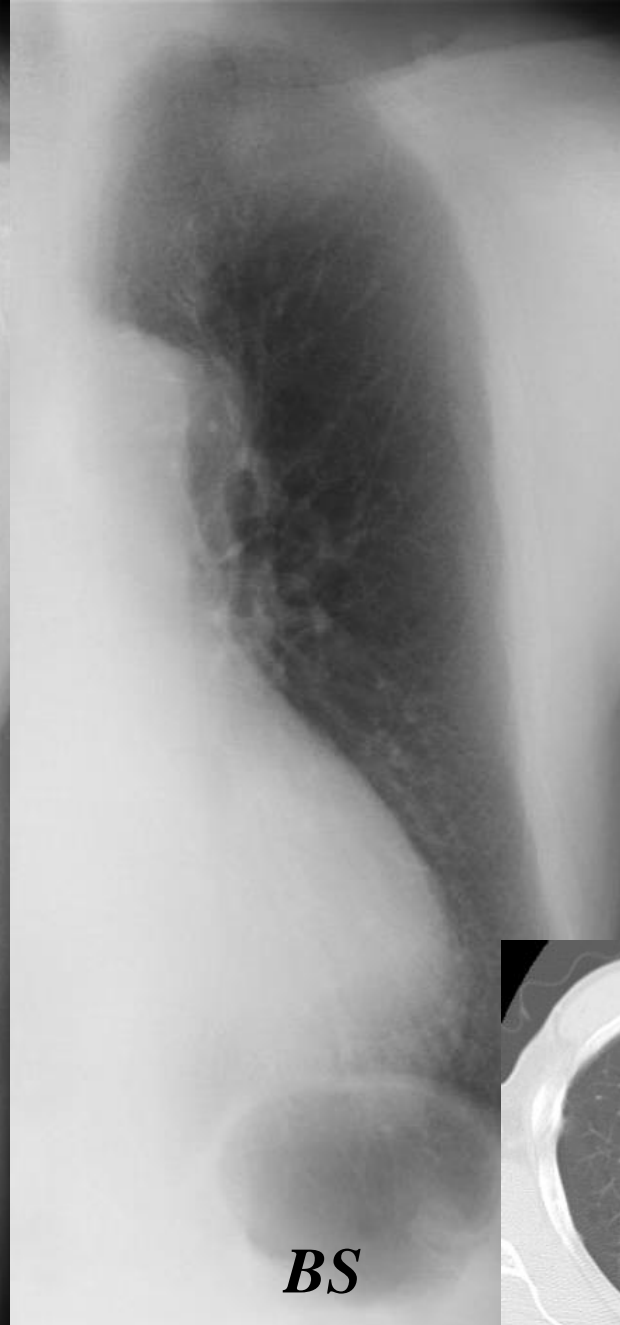
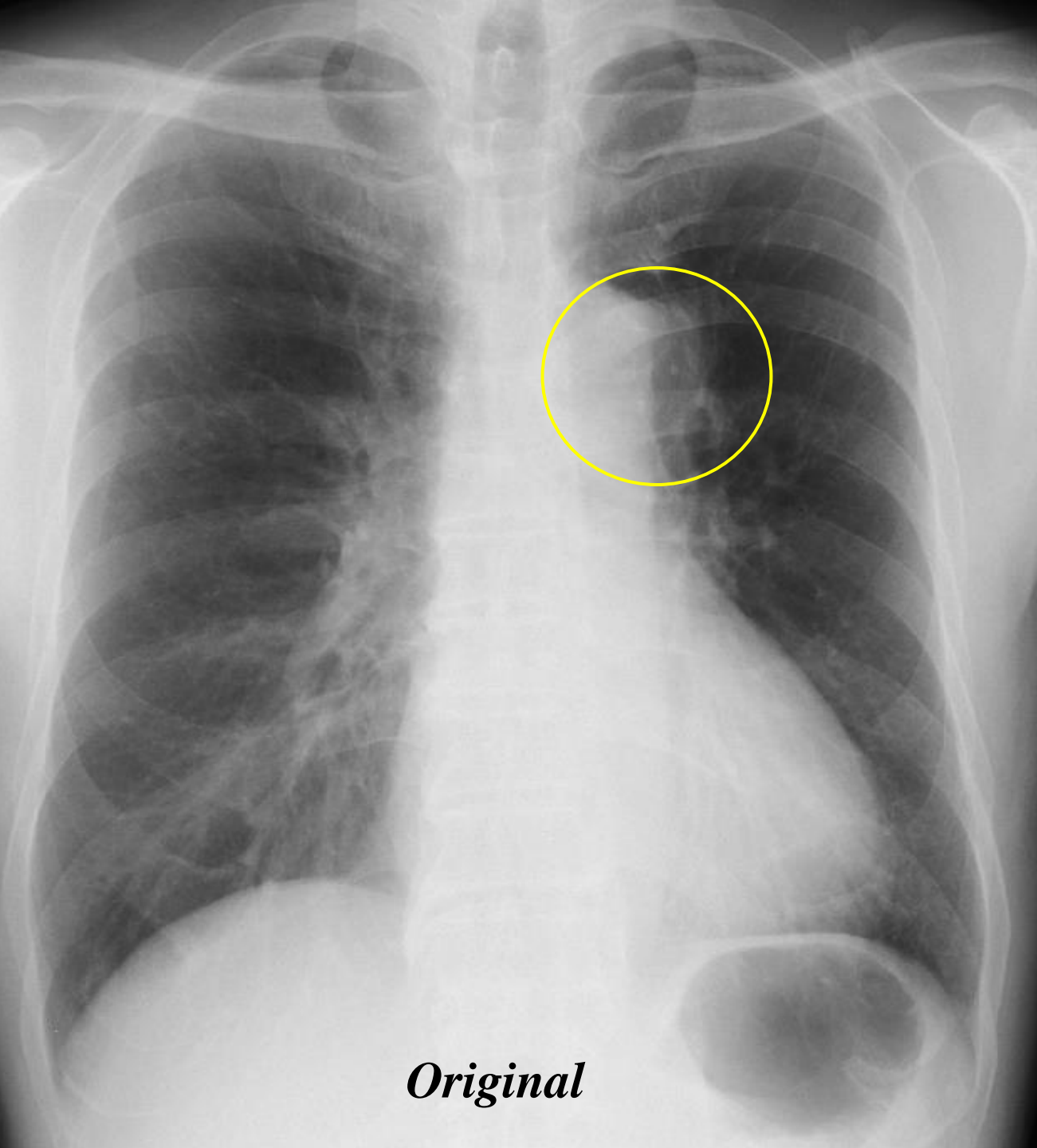


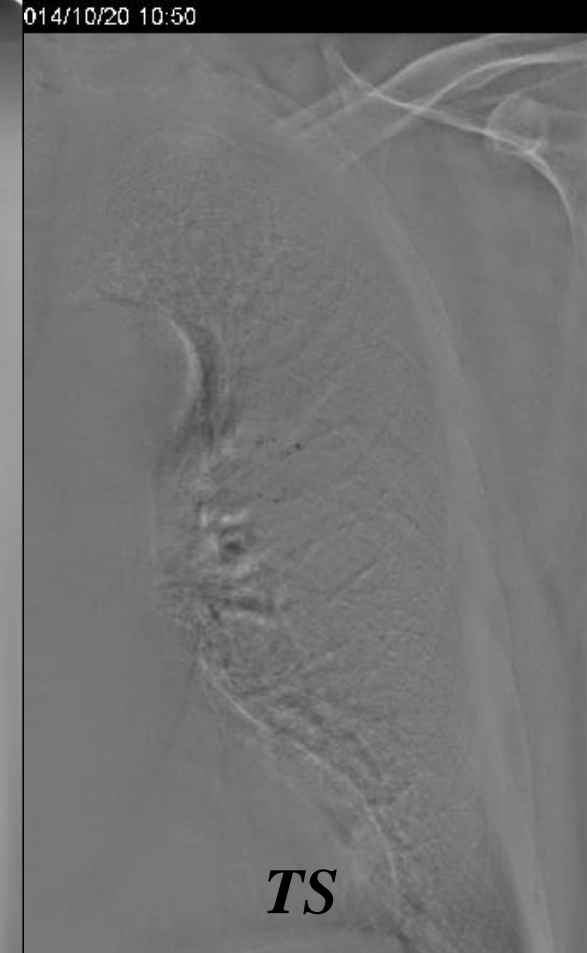
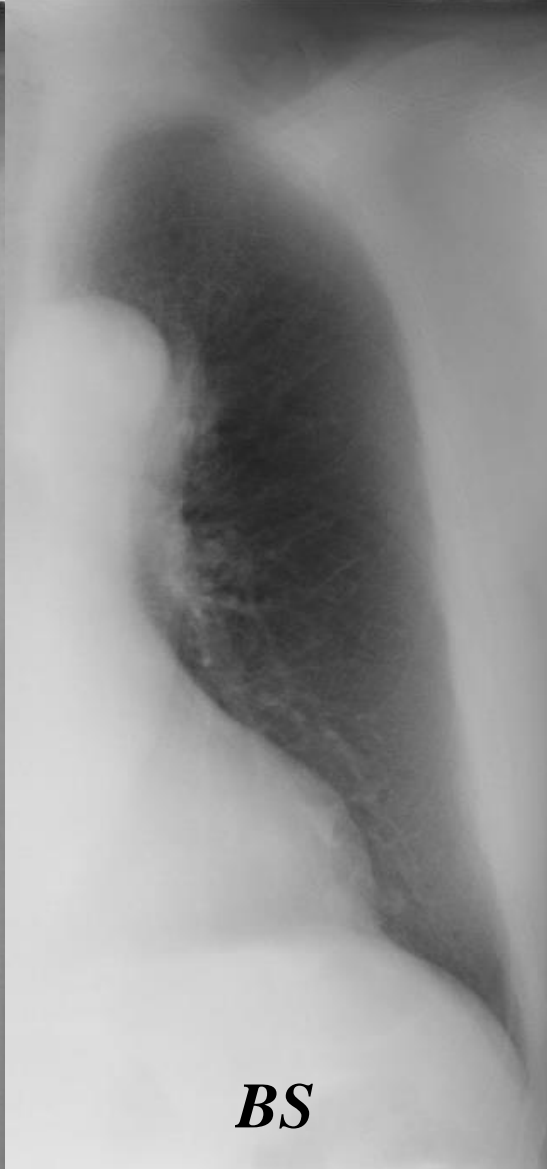
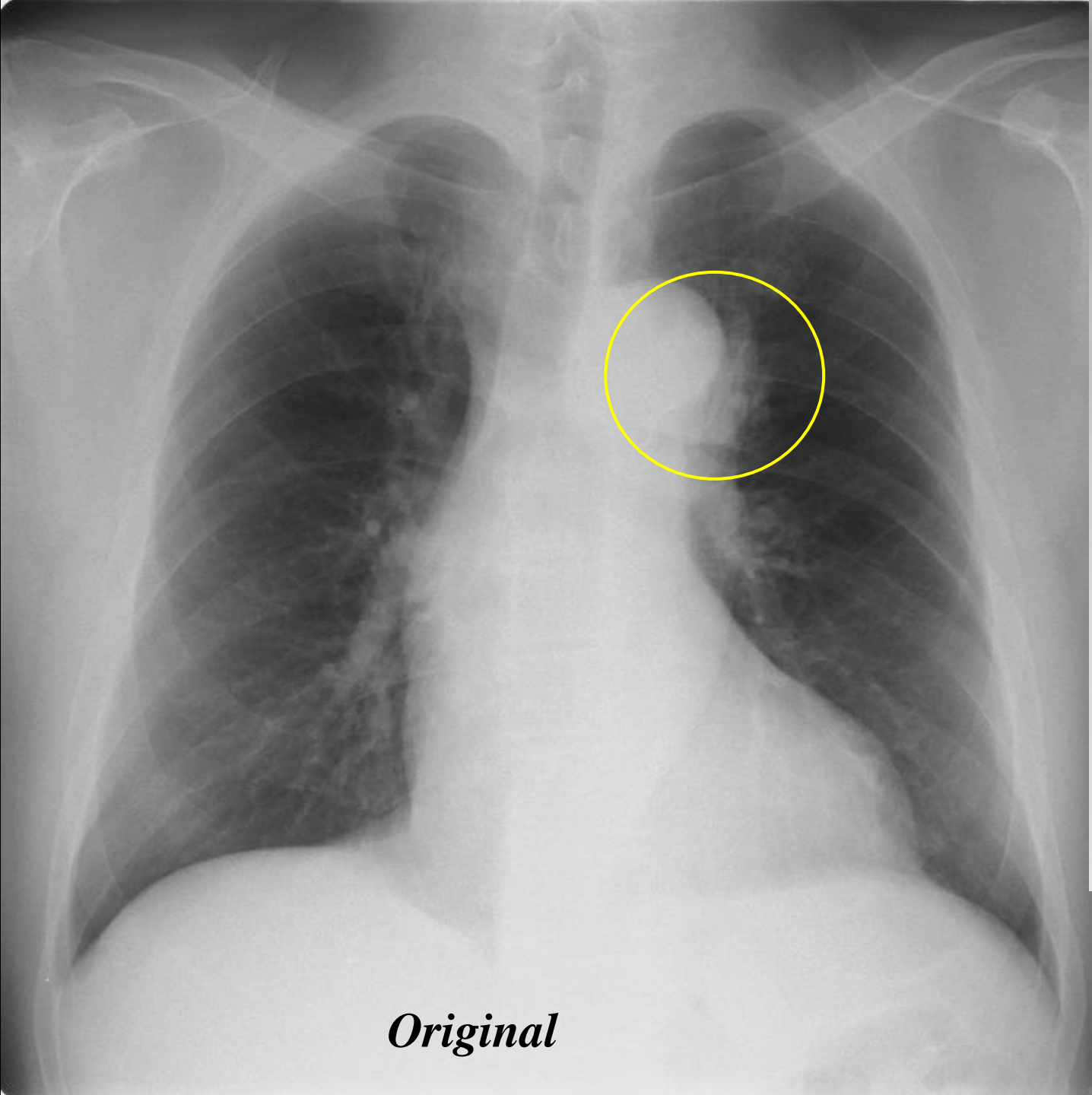
*TS*

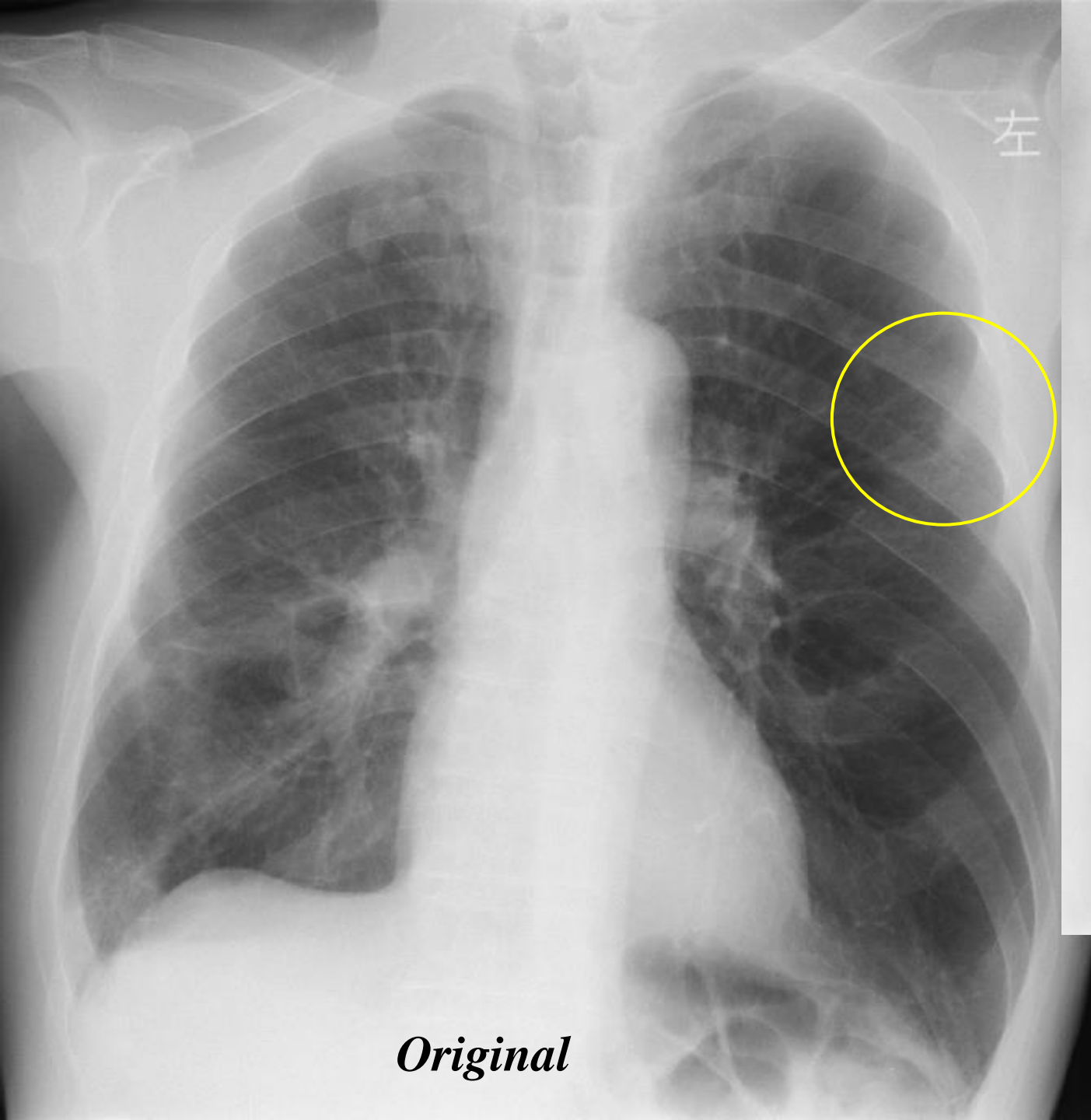


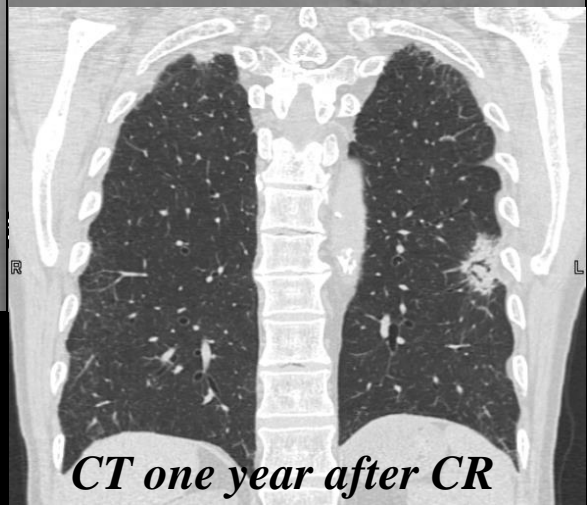
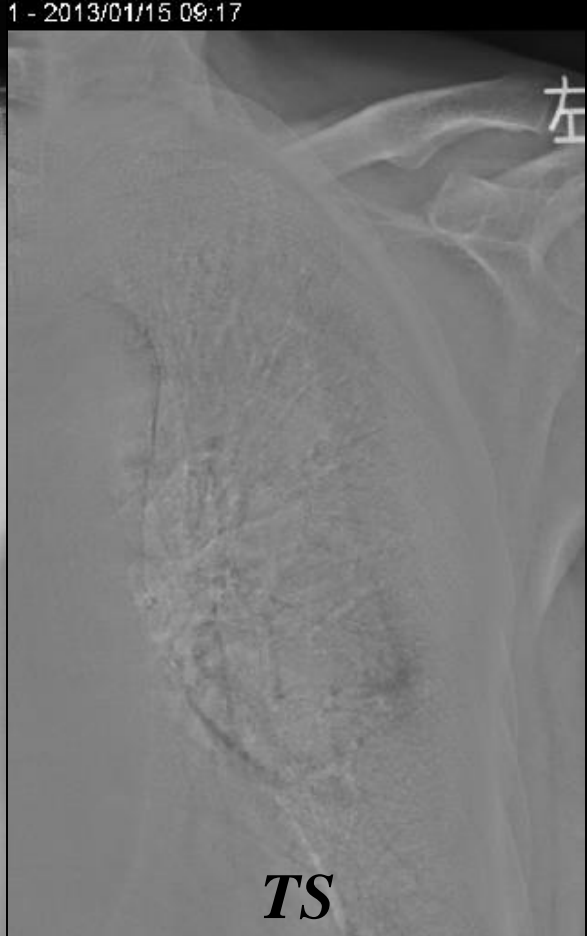
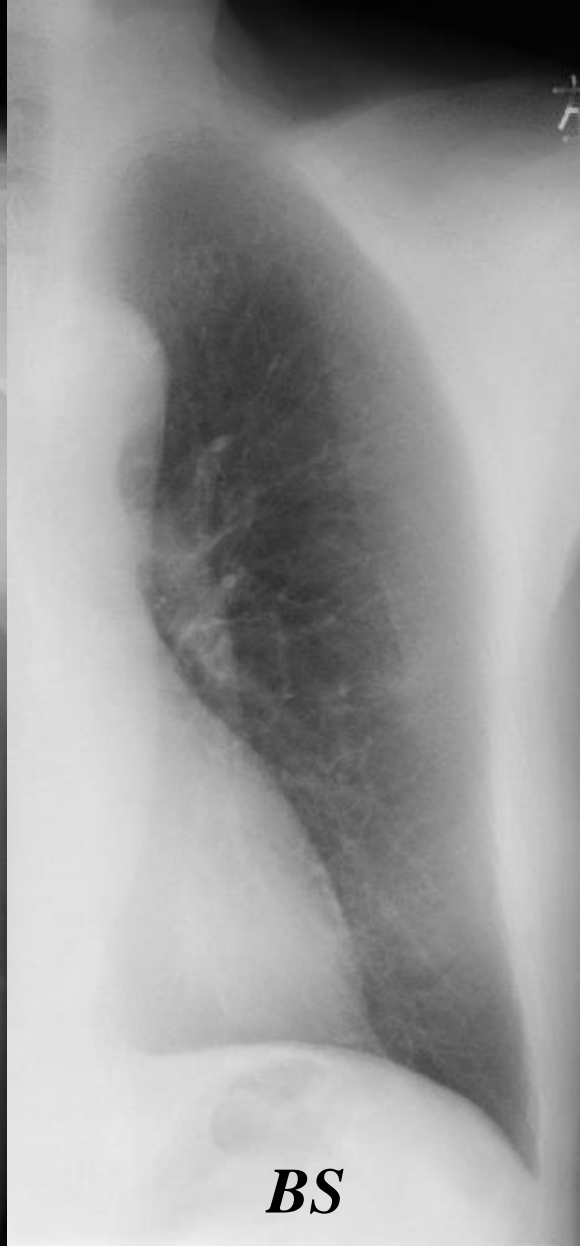
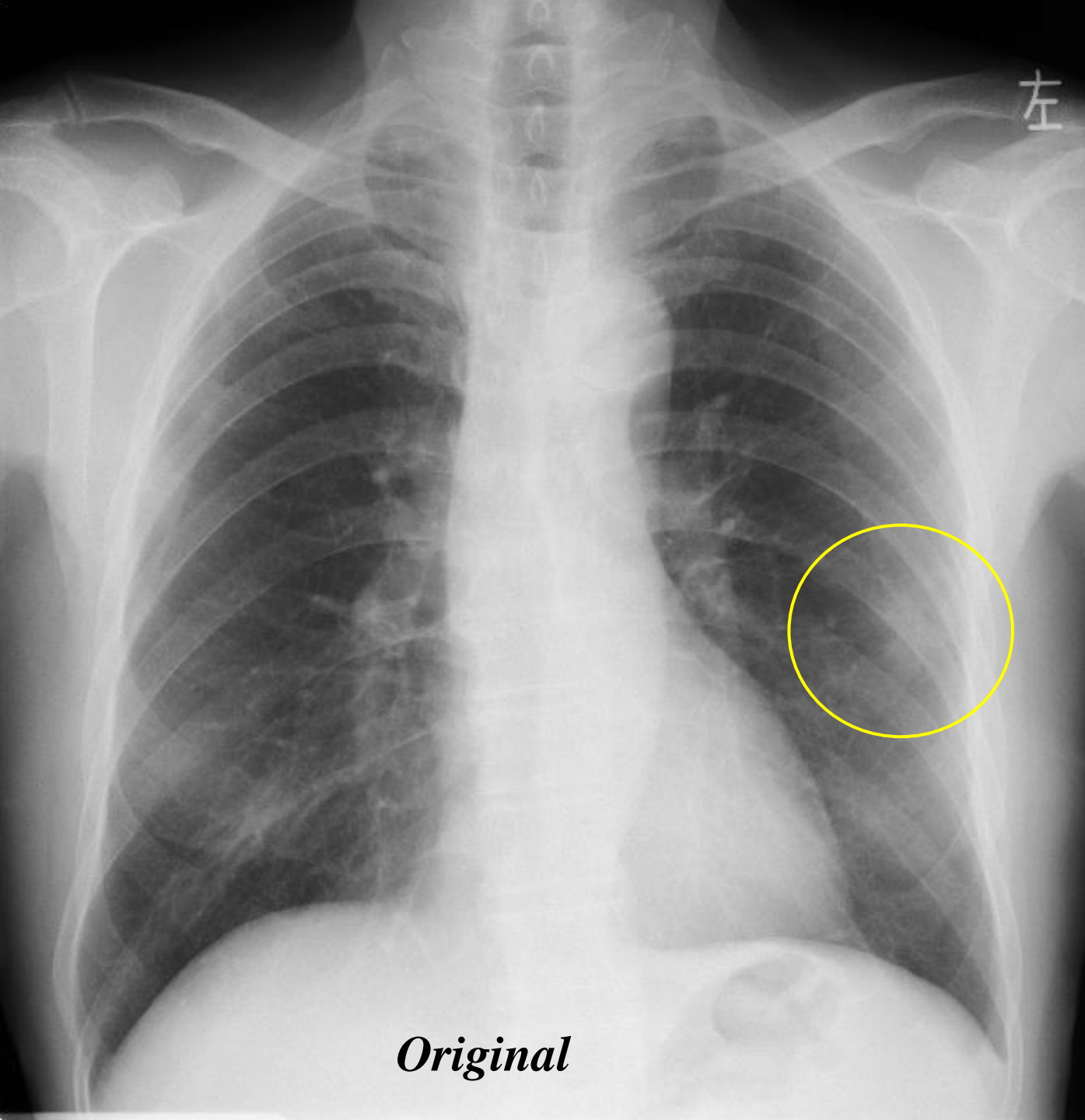
*CT one year after CR*

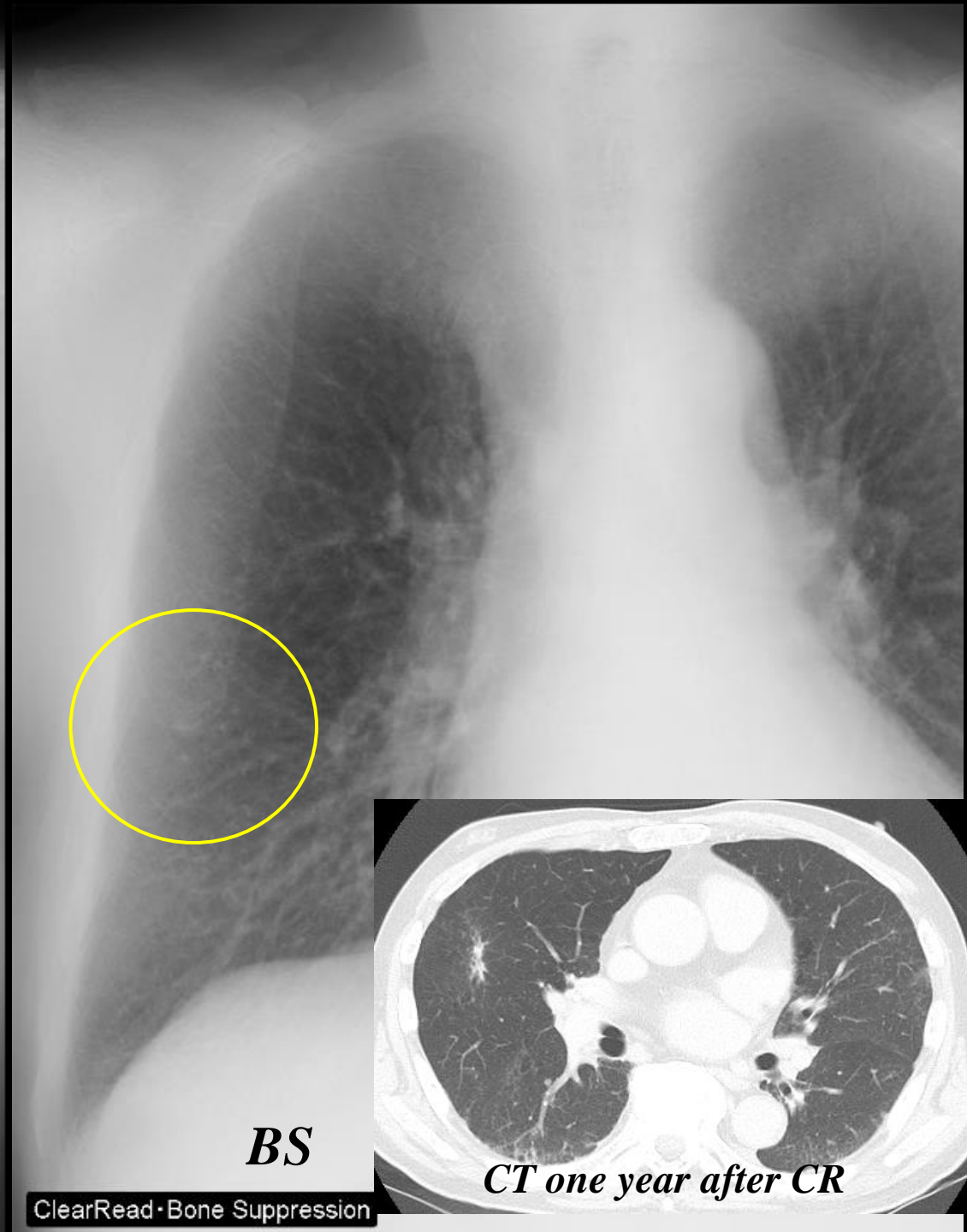
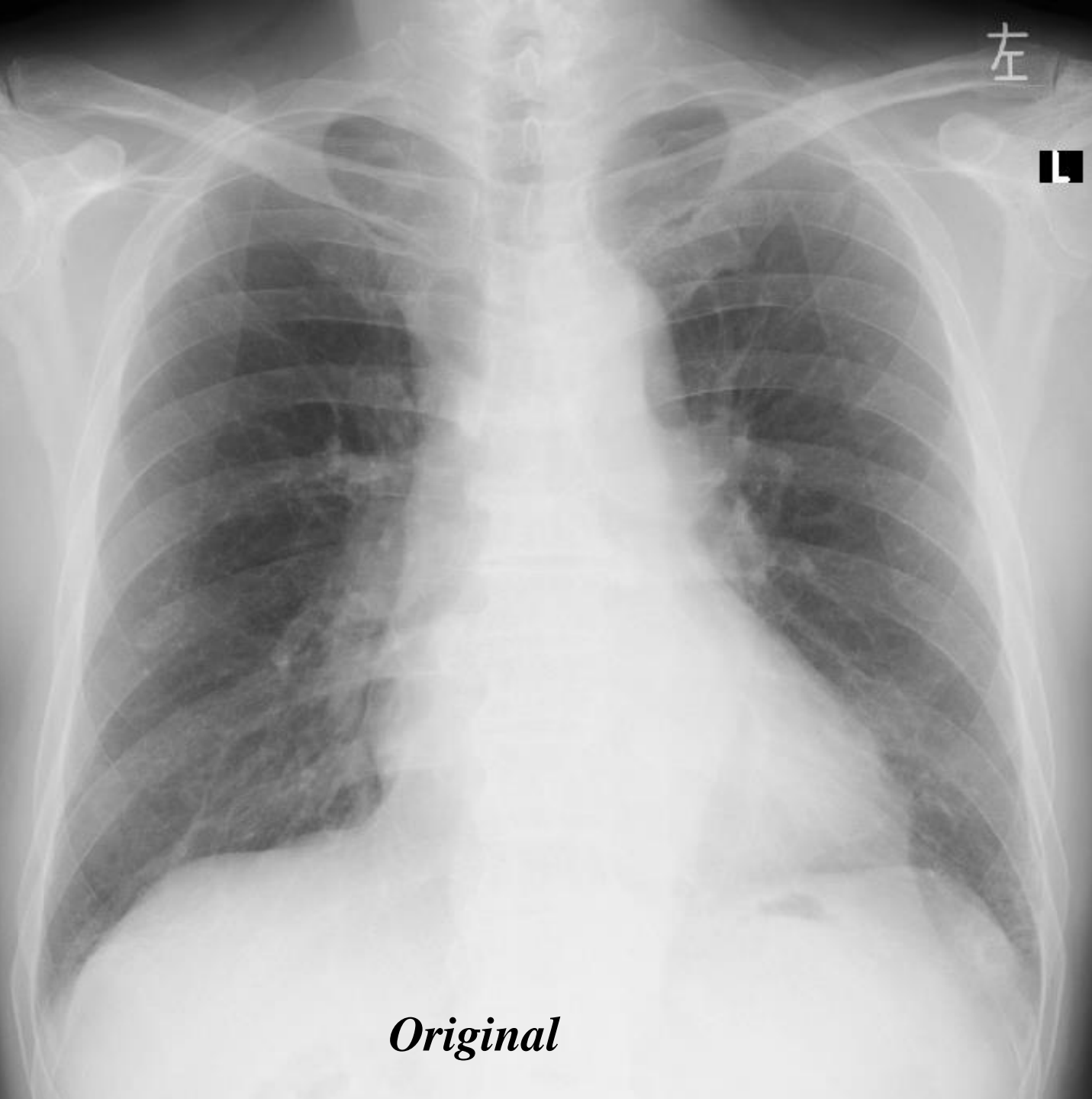


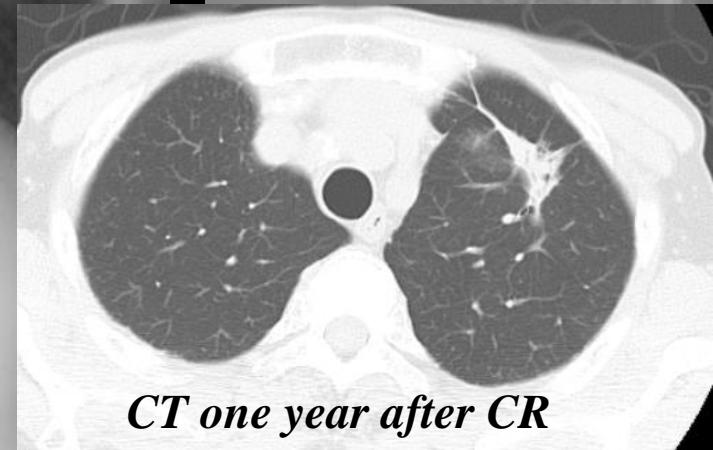
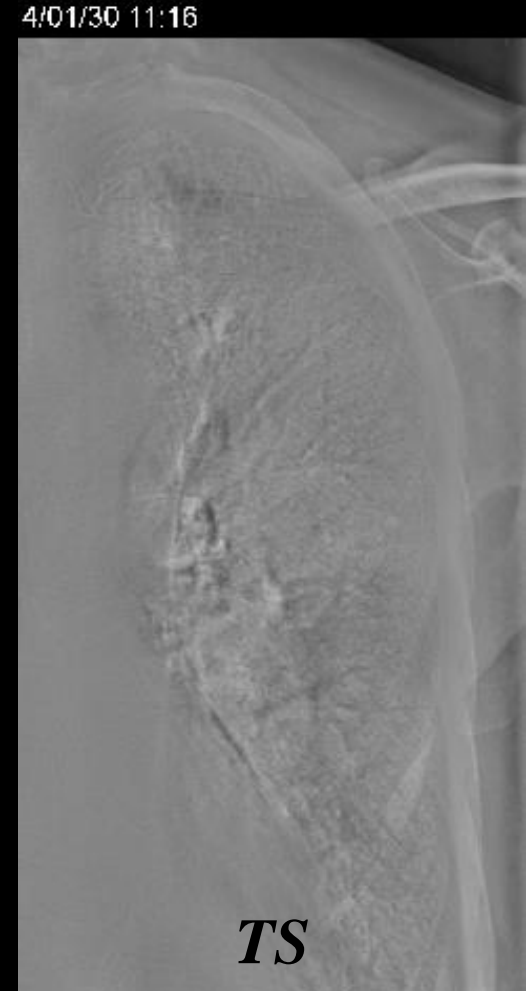
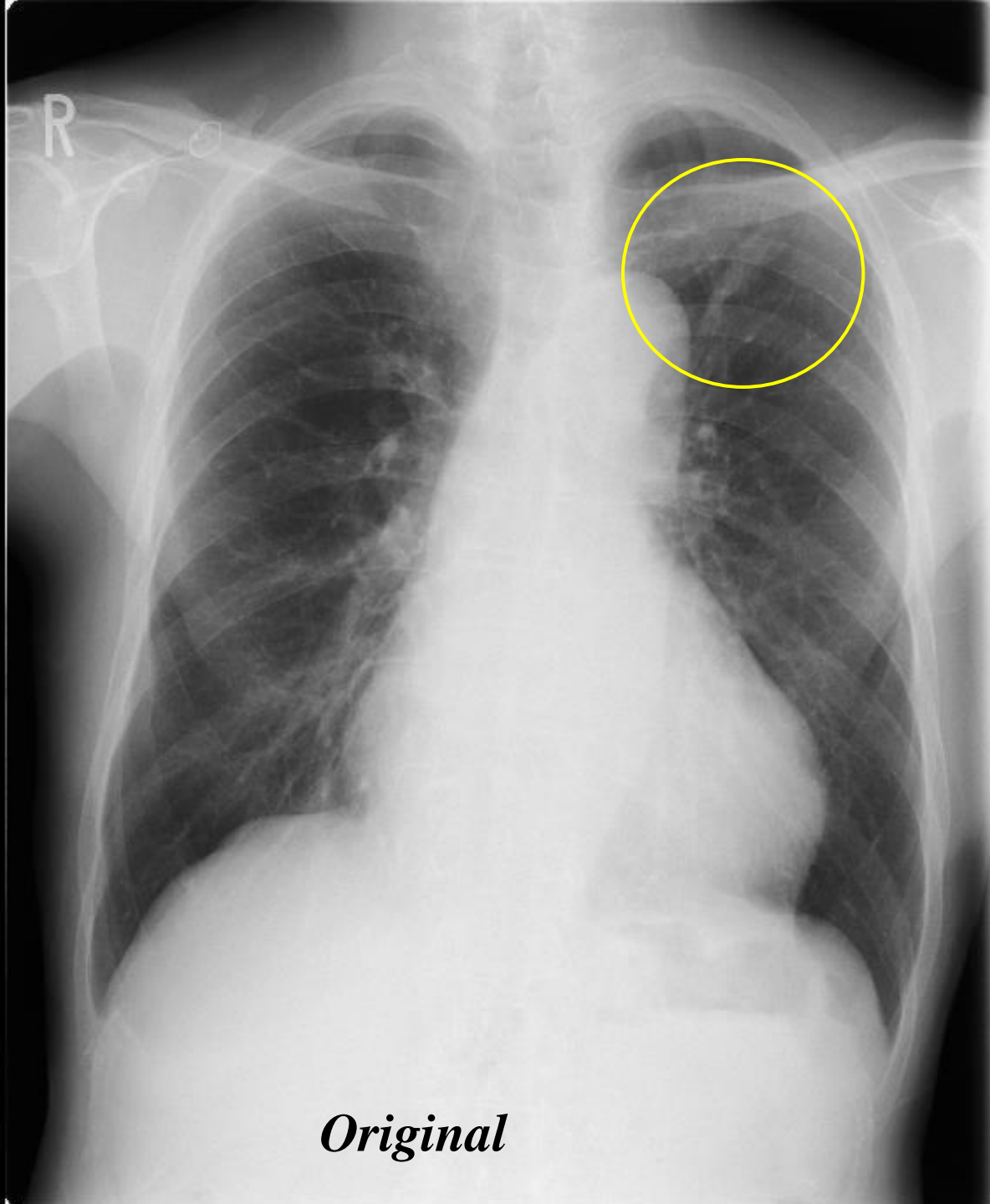


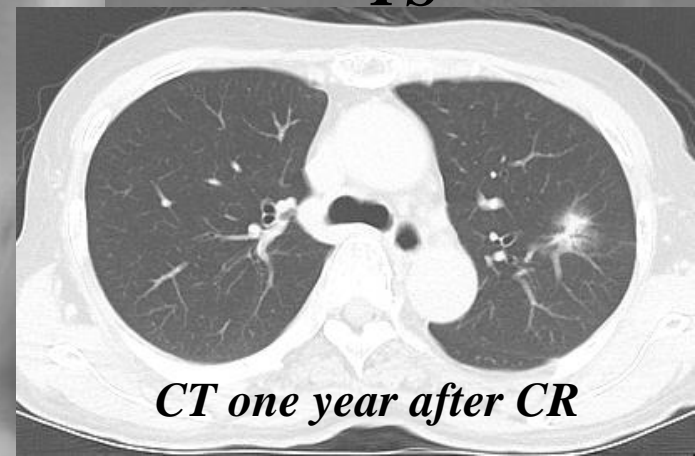
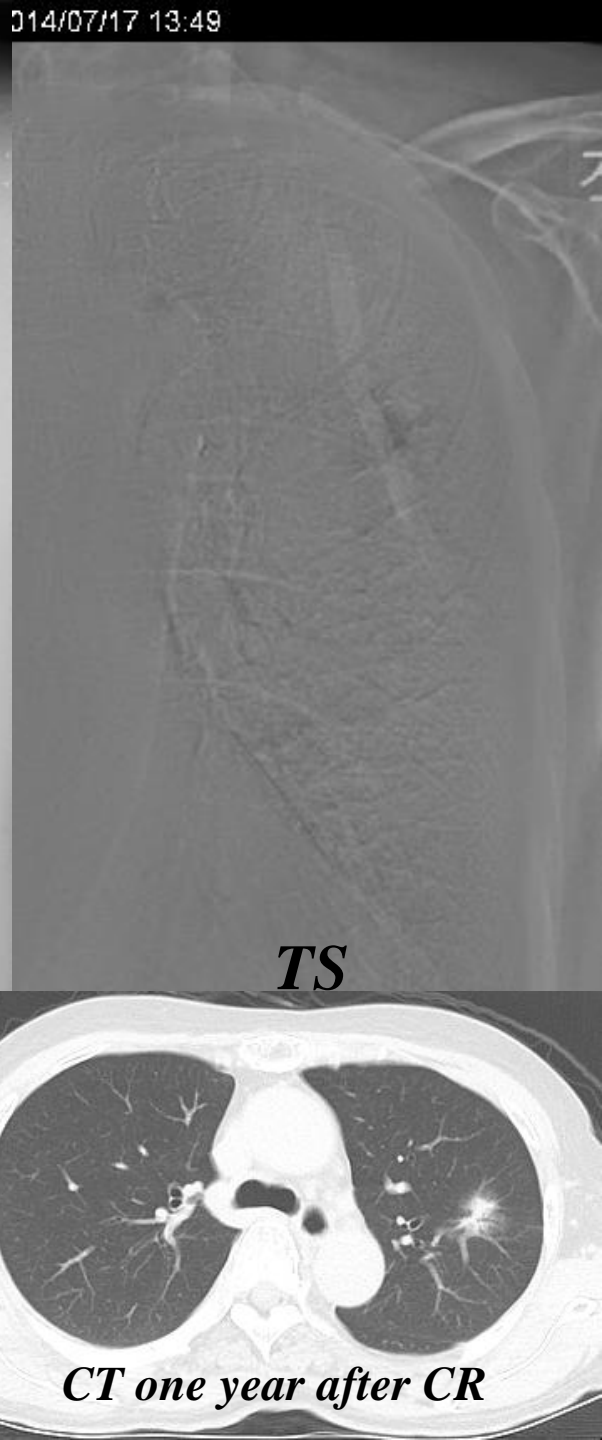
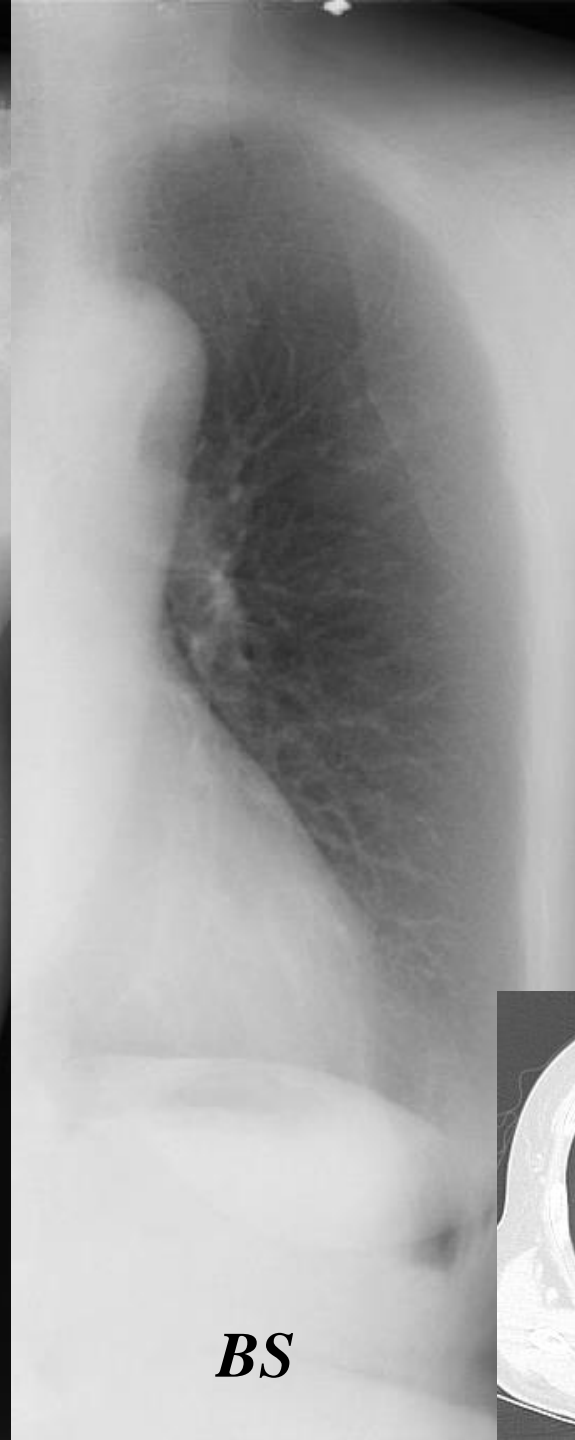
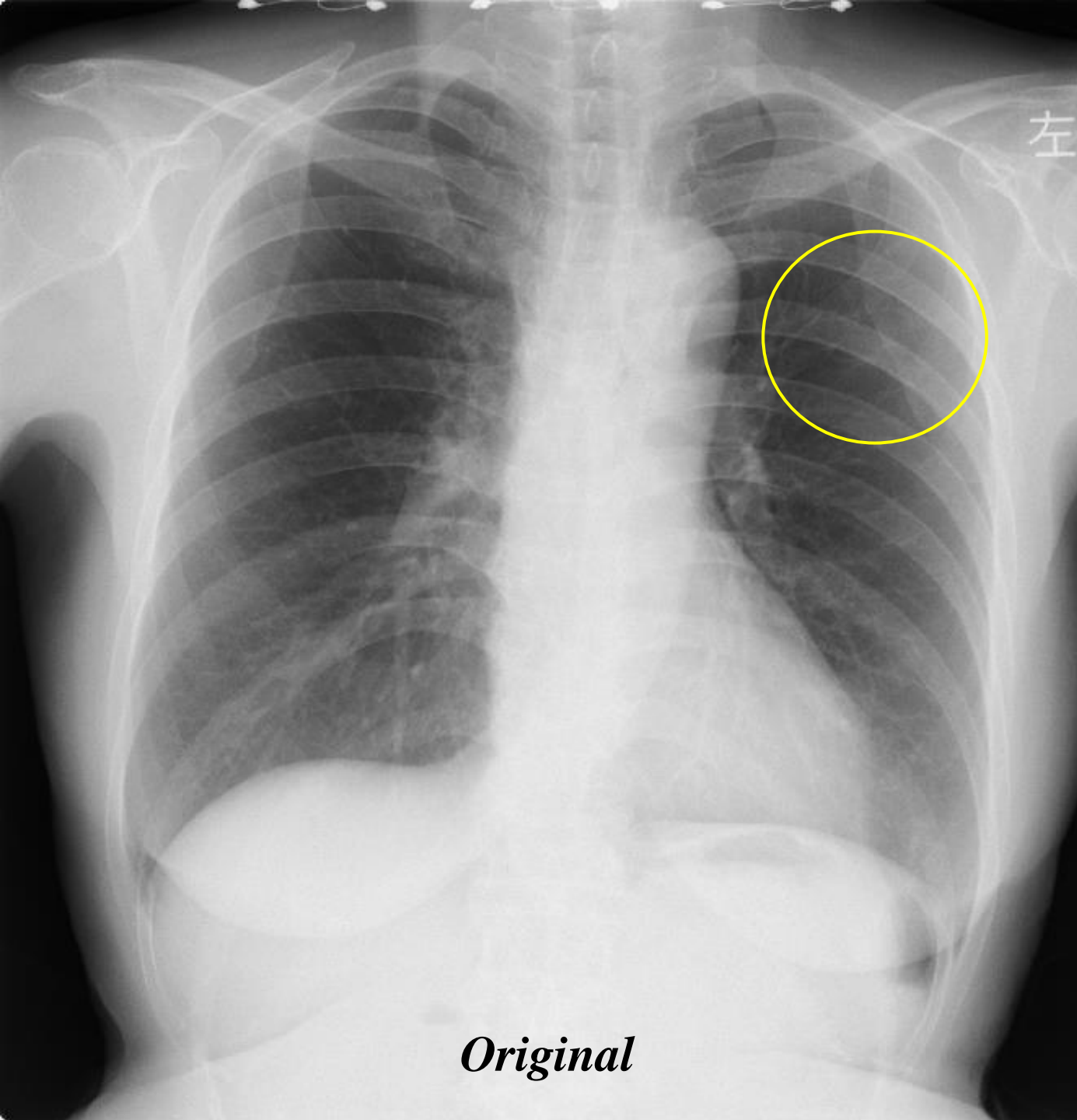


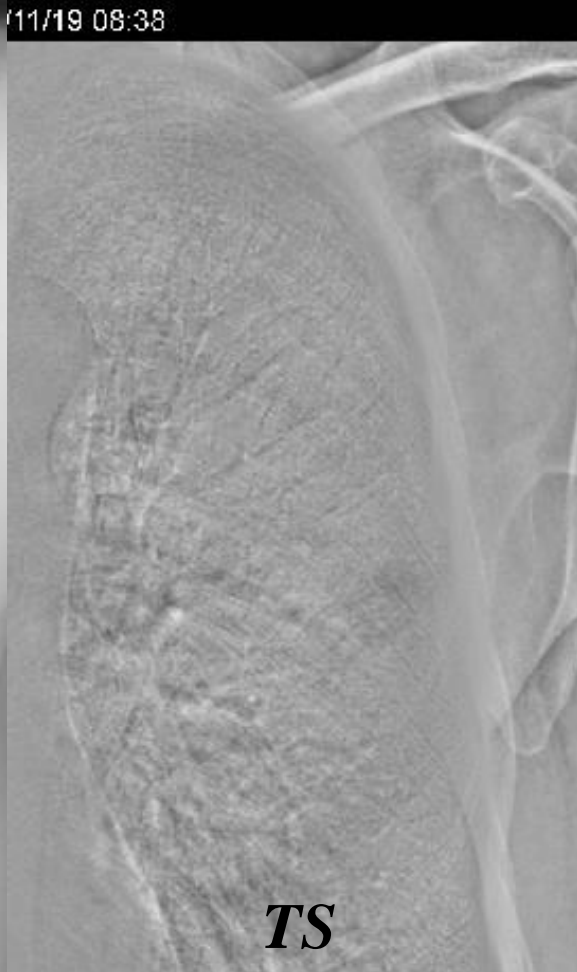
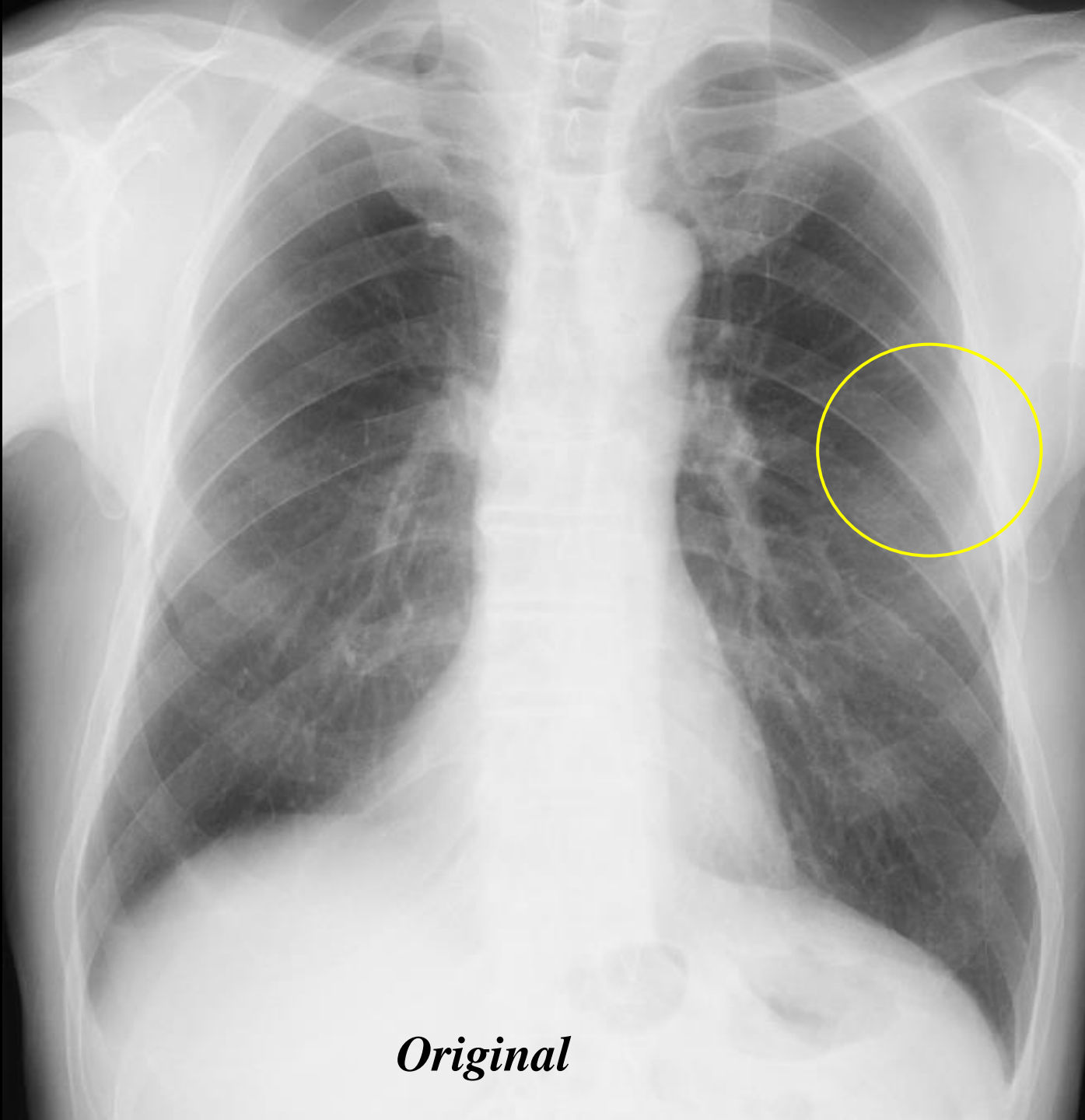




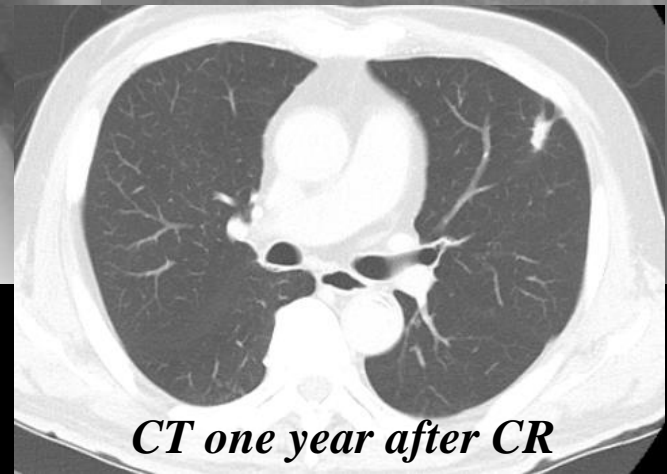
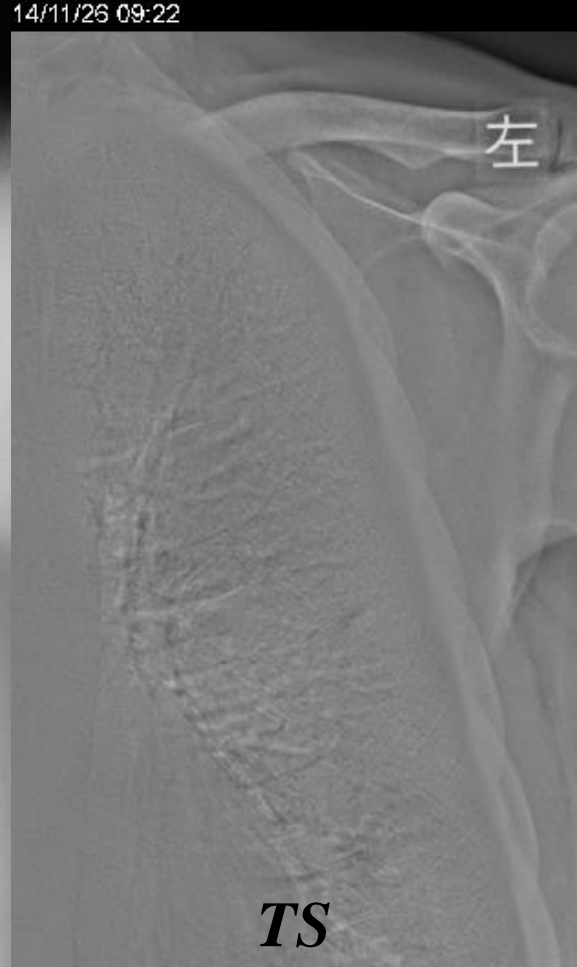
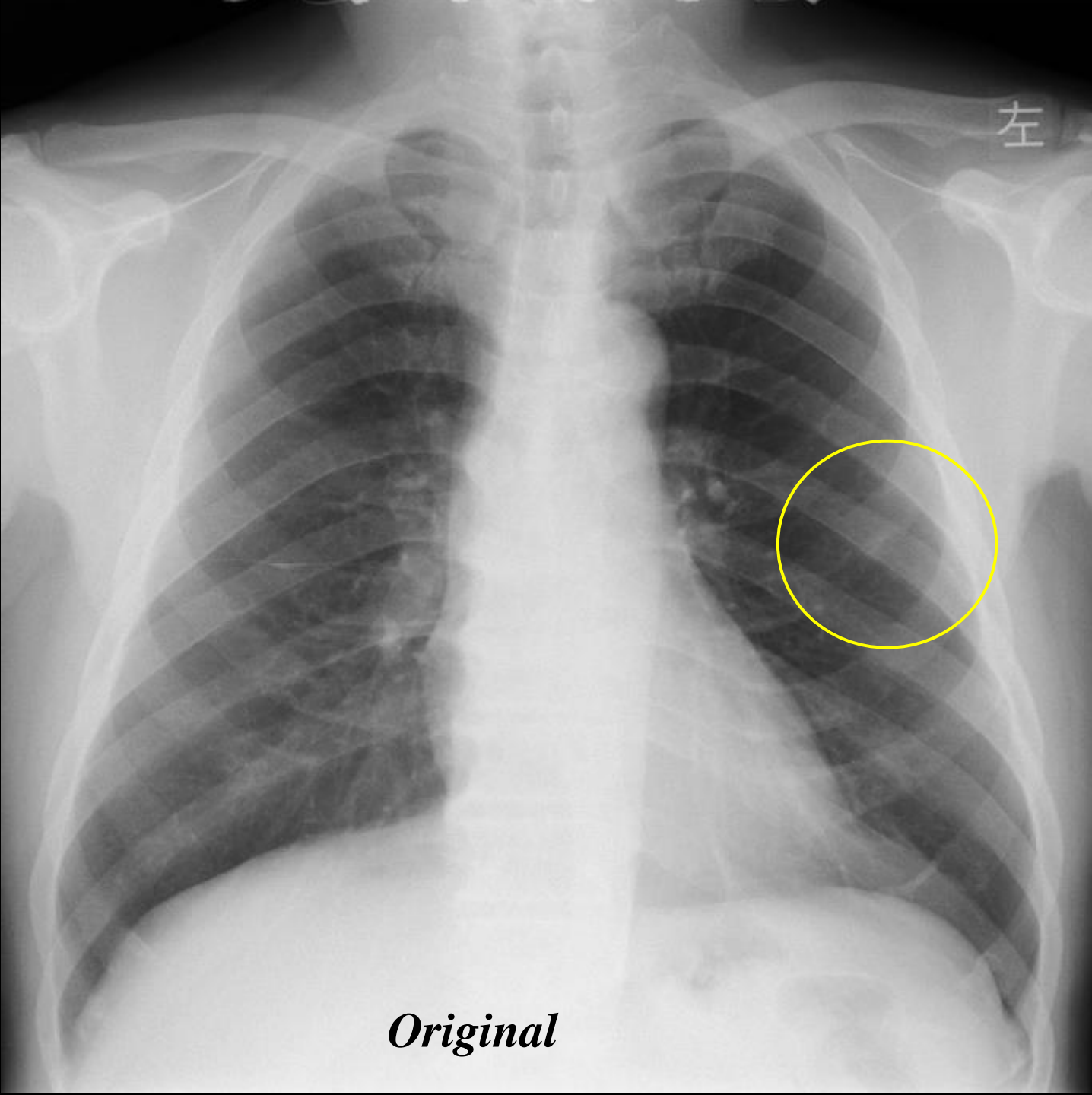


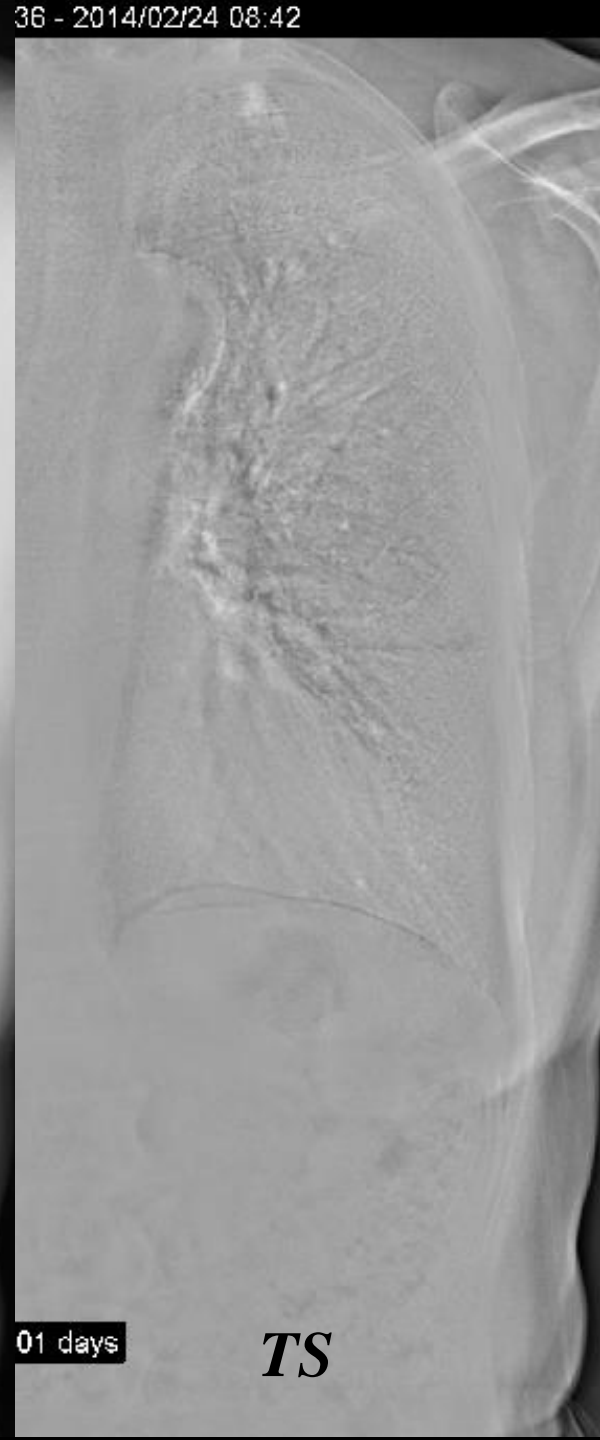
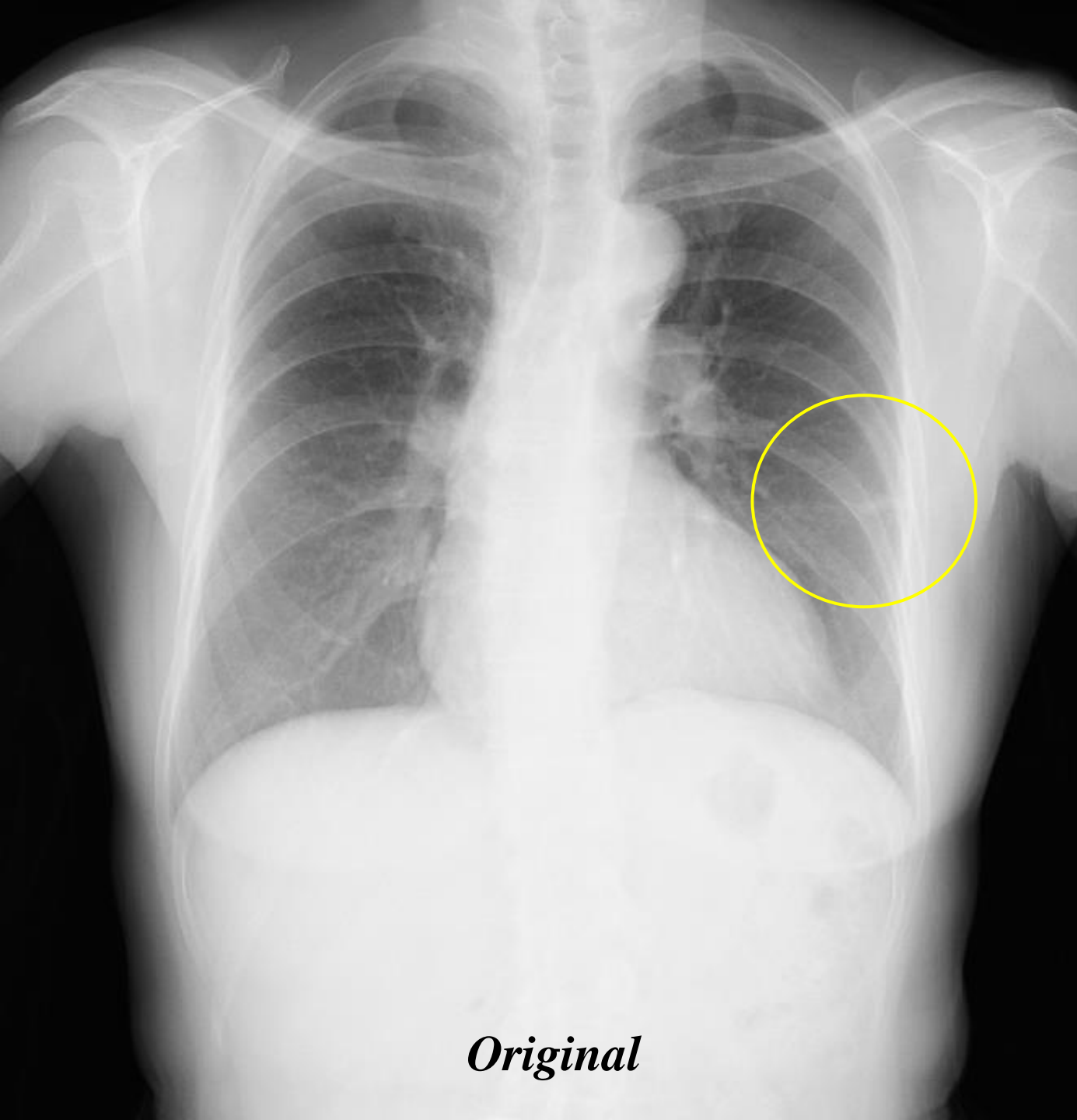












# Conclusion

By using bone-suppression algorithm and temporal-subtraction algorithm, it became possible to detect lung cancer in an earlier stage.

1. Muhm JR, et al. Radiology. 1983 Sep;148(3):609-15.
2. Sasaki Y, Katsuragawa S, et al: Usefulness of temporally subtracted images in the detection of lung nodules at digital radiography. Radiology 201 (P):400, 1996.
3. Suzuki K, Doi K, et al: Image-processing technique for suppressing ribs in chest radiographs by means of massive training technique for artificial neural network (MTANN).IEEE Trans Med Imaging.25 406-416. 2006.
4. Freedman M, Lo B, Seibel J, and Bromley E. Improved detection of lung nodules with novel software that suppresses the rib and clavicle shadows on chest radiographs. Radiology. July 2011. 260, 265-273.