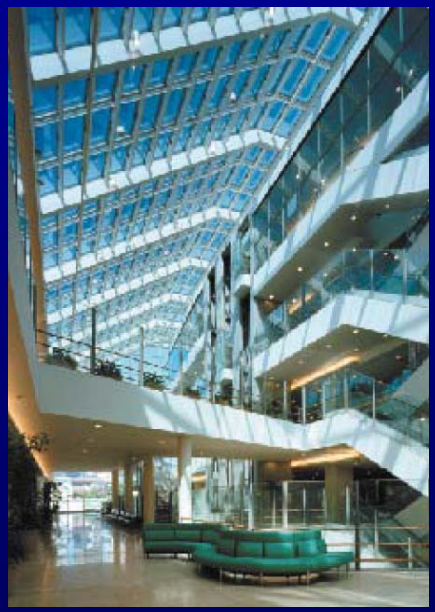

Integration of Temporal Subtraction and Nodule Detection System for Digital Chest Radiographs into PACS

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and Nuclear Medicine
Tokyo Women's Medical University,
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SJRS 2010, Vejle, Denmark, 9/6-7, 2010

Computer Aided Diagnoses (CADs) for Chest Radiography

- Temporal subtraction
- Nodule detection
- Massive training artificial neural network (MTANN)
- Differential diagnosis of pulmonary nodule
- Measurement of cardiac-thoracic ratio
- Categorization of interstitial lung disease
- Patient recognition using an image-matching technique
- Etc.

Temporal Subtraction

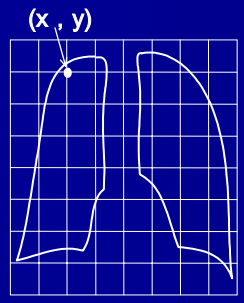
Current

Previous

Pleural Effusion

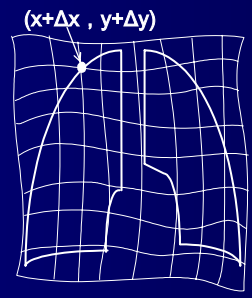
Temporal subtraction is a technique in which a previous chest radiograph is automatically registered with and subtracted from a current radiograph in order to enhance interval changes.

Previous Image



Non-Linear Warping

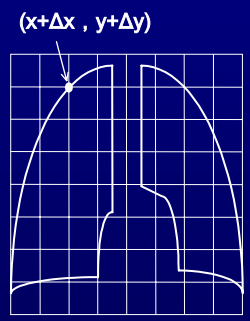
Warped Previous Image

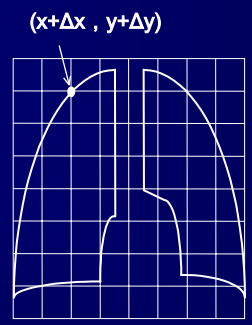


Subtraction

Subtracted Image

Current Image





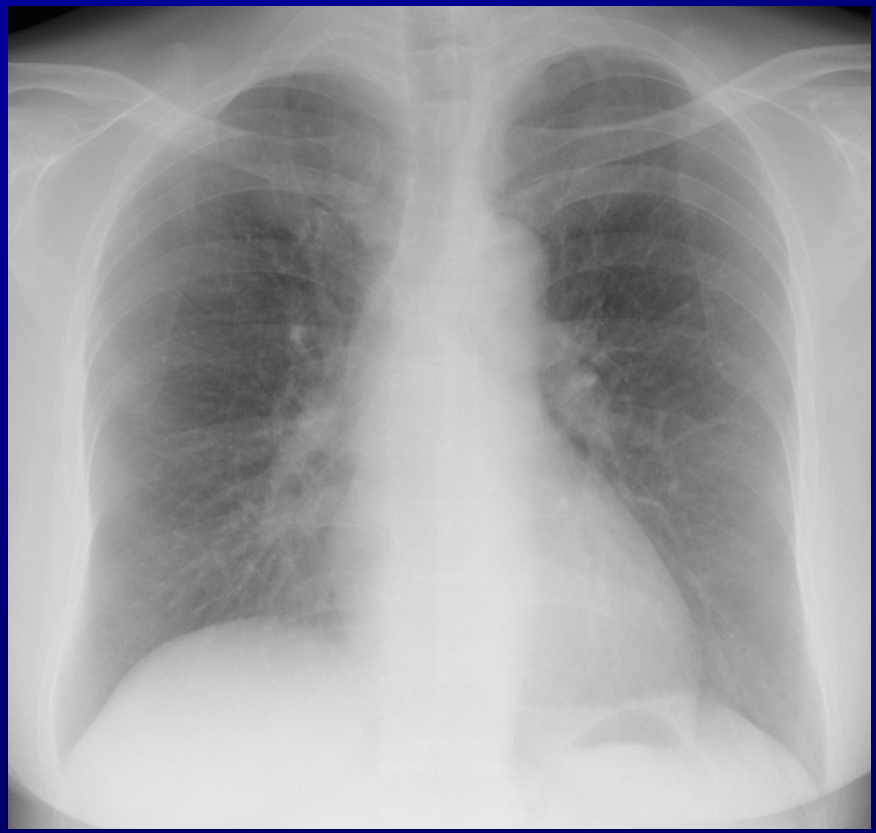
This technique is based on non-linear warping registration.

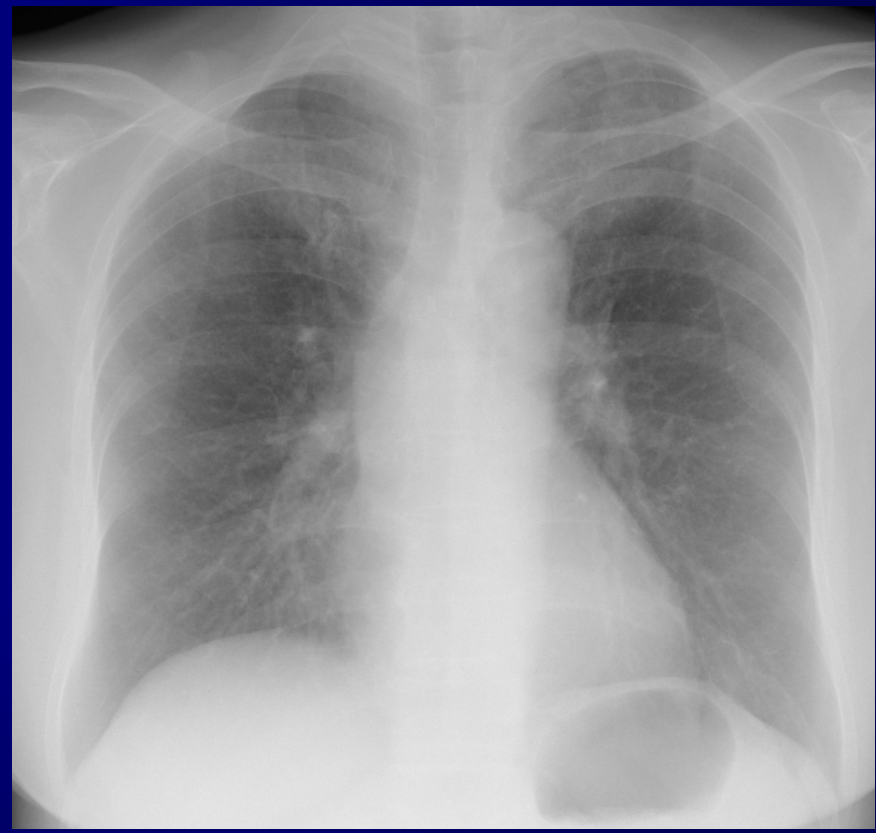
Courtesy of Mitsubishi Space Software

Three months later

24-year-old male was followed-up for osteosarcoma.

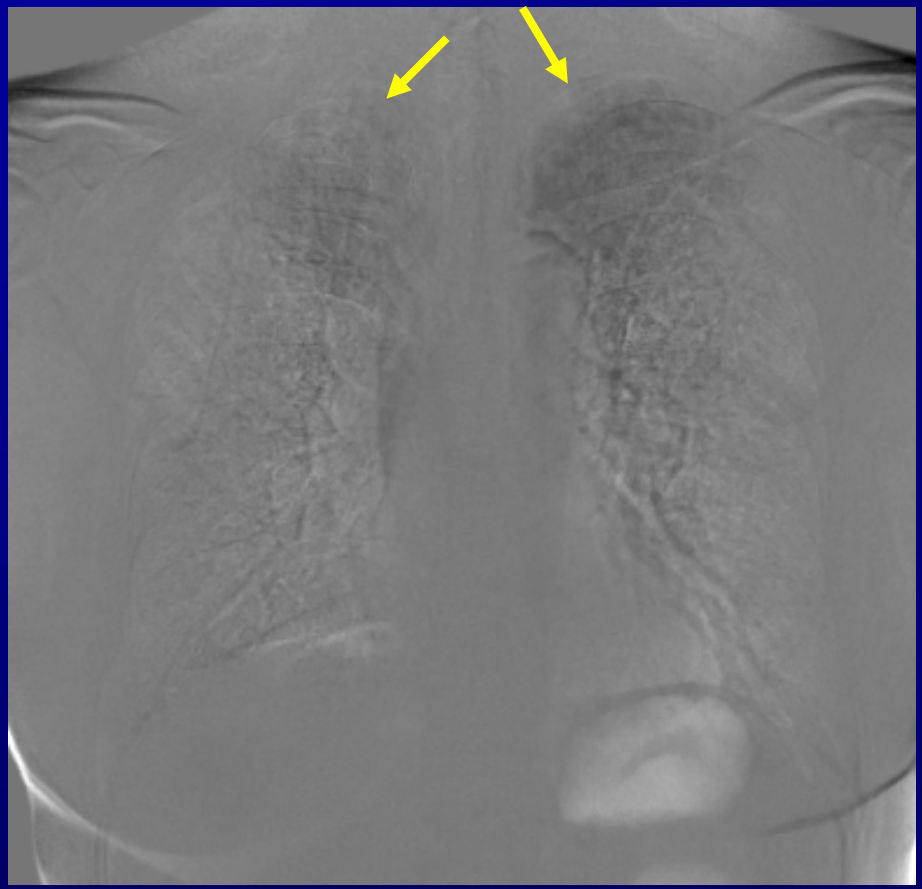
Diagnosis: Lung Metastasis

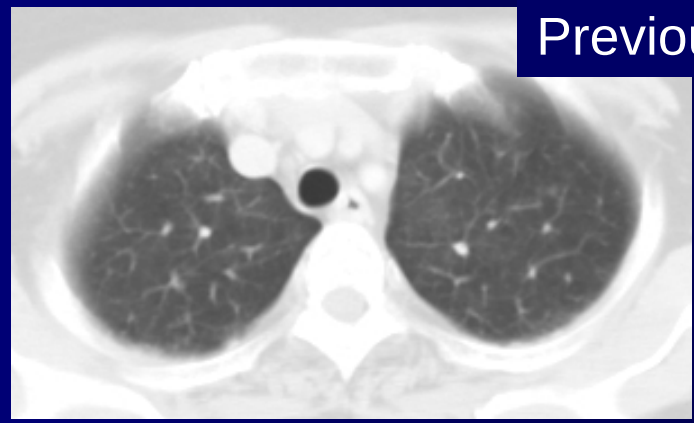


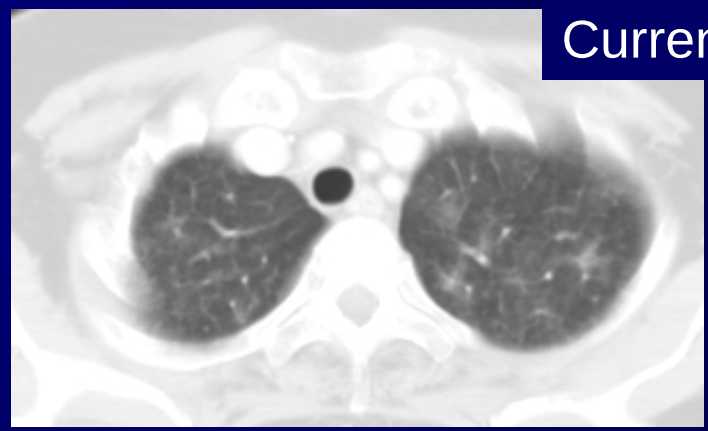


Six weeks later

58-year-old female underwent radiotherapy for malignant lymphoma.

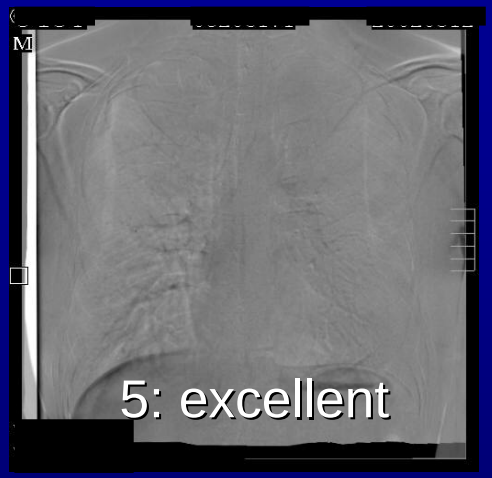


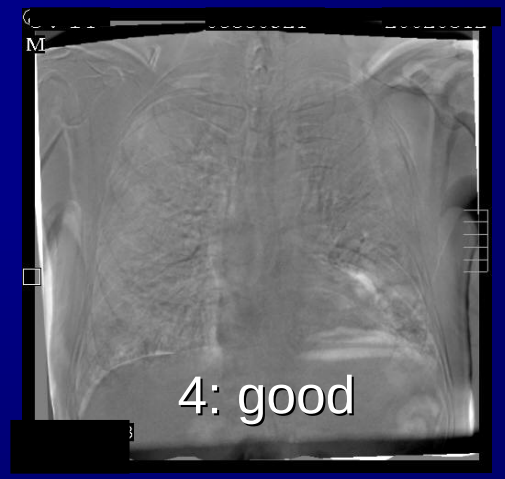


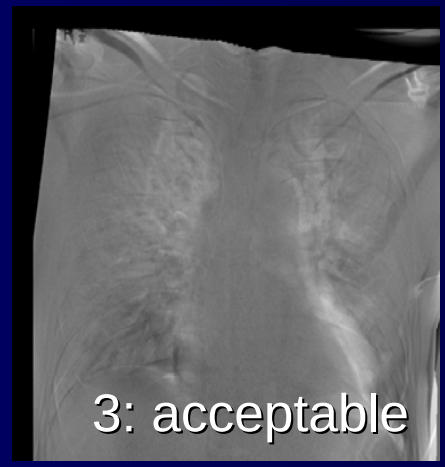


Diagnosis: Radiation Pneumonitis

Evaluation of the Image Quality of Temporal Subtraction in PACS environment







Tab.1 Ratio of Warping Mode to Non-Warping Mode and Subjective Image Quality in Two Positions

Position	Mode	Number	Subjective Image Quality	
Upright			4.2	
	Warping	55 (100%)	4.2	
	Non-warping	0 (0%)		
Supine			2.9	
	Warping	46 (74%)	3.1	p<.01
	Non-warping	16 (26%)	2.7	

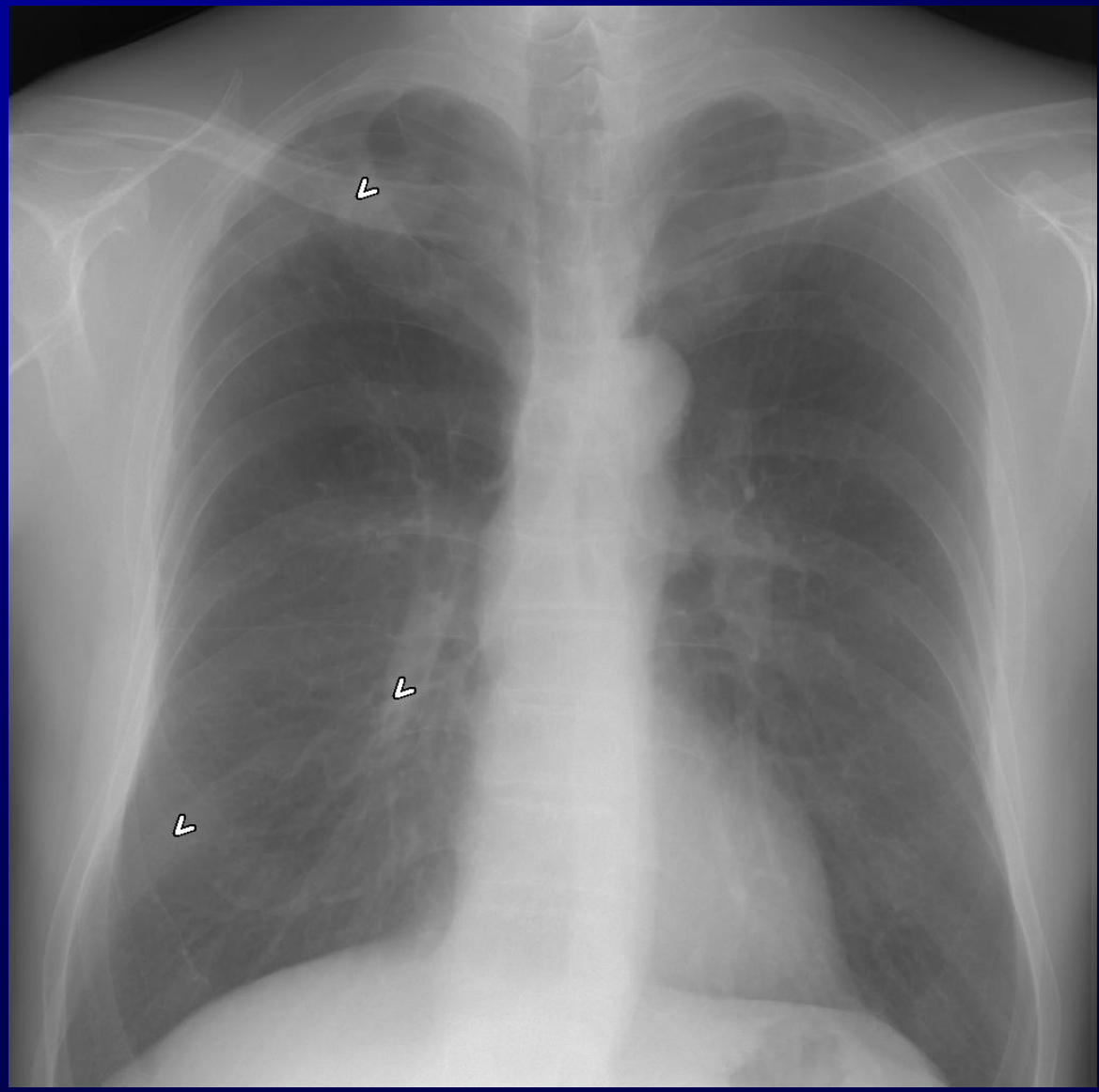
Mann-Whitney test

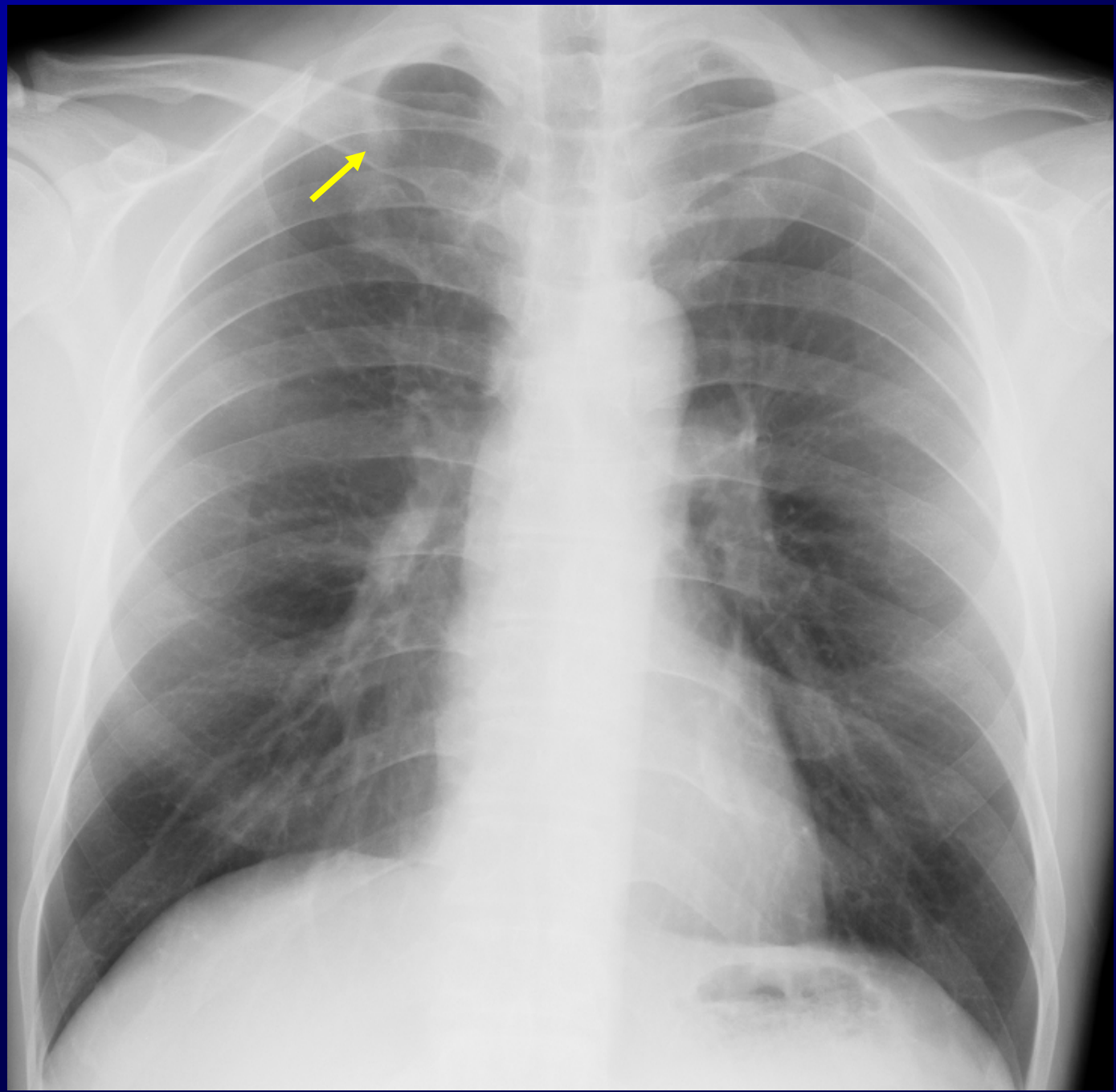
Conclusion of this Study

- The percentages of acceptable temporal subtraction images were 100% in the upright position and 66% in the supine positions.
- In the upright position, temporal subtraction images were acceptable quality for clinical use.

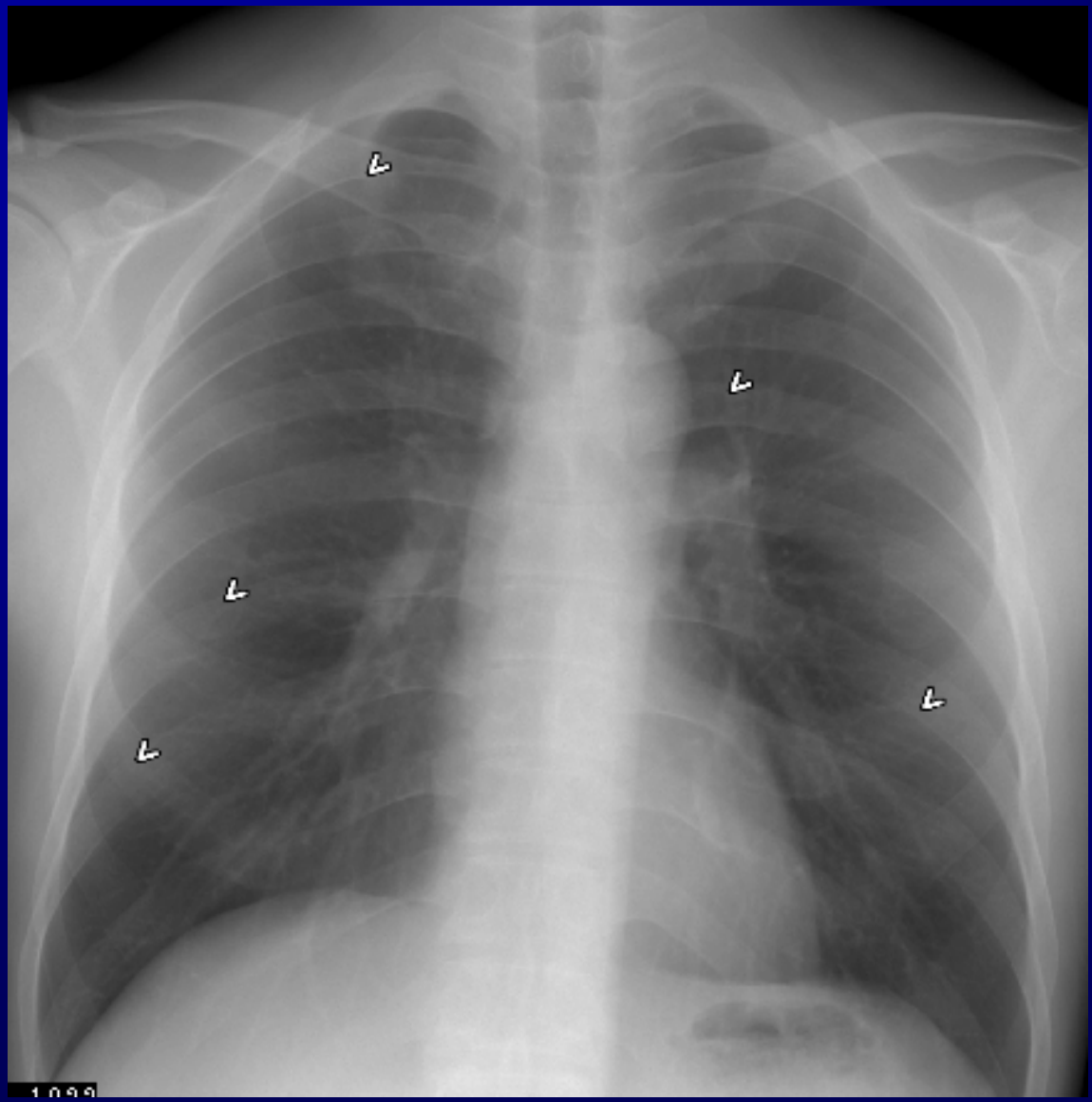
Sakai S, et al. J Digit Imaging 2006

Nodule Detection

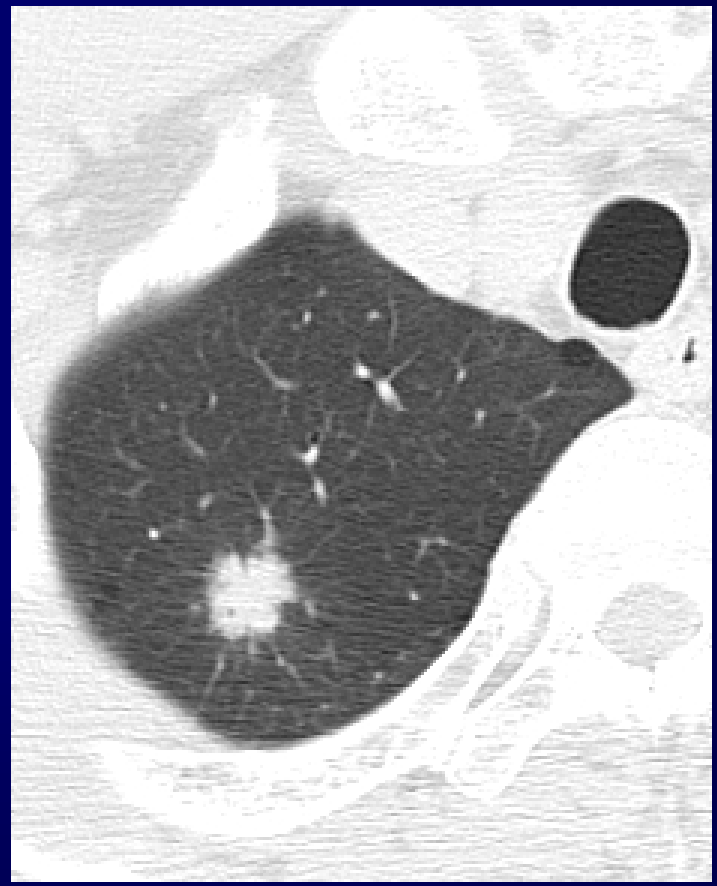




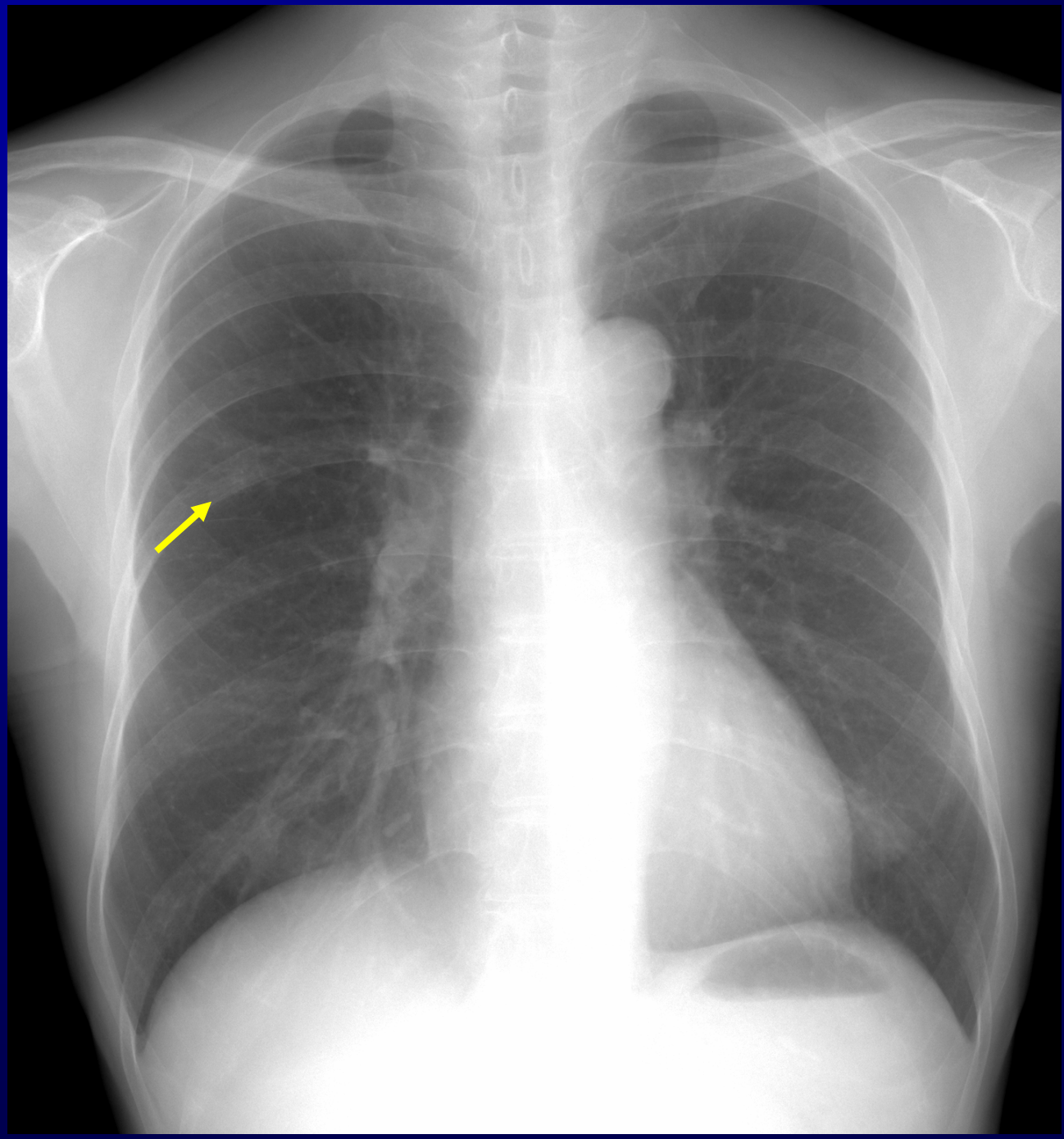
43 y/o M



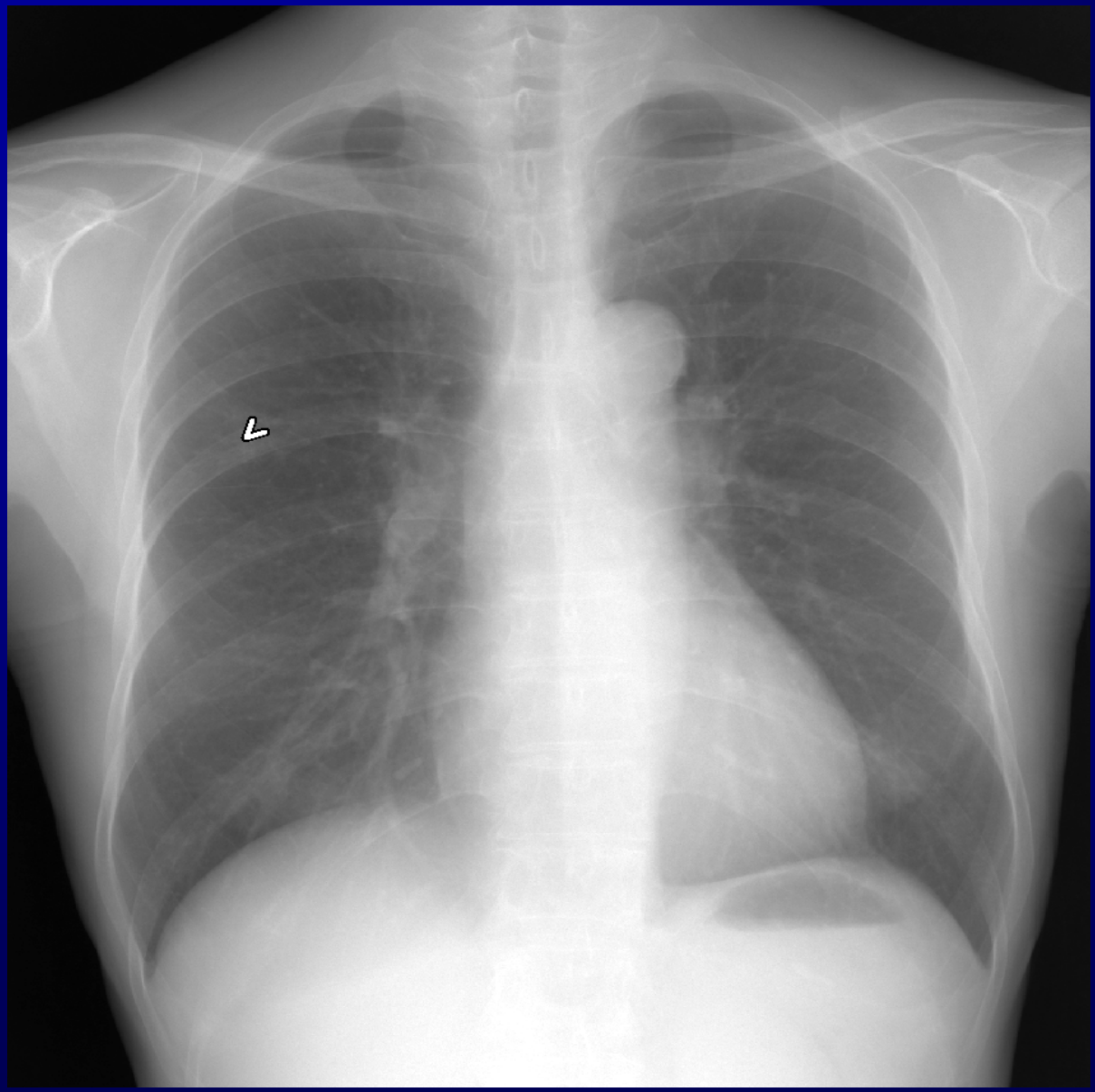
Nodule detection image



HRCT



64 y/o F



Nodule detection image

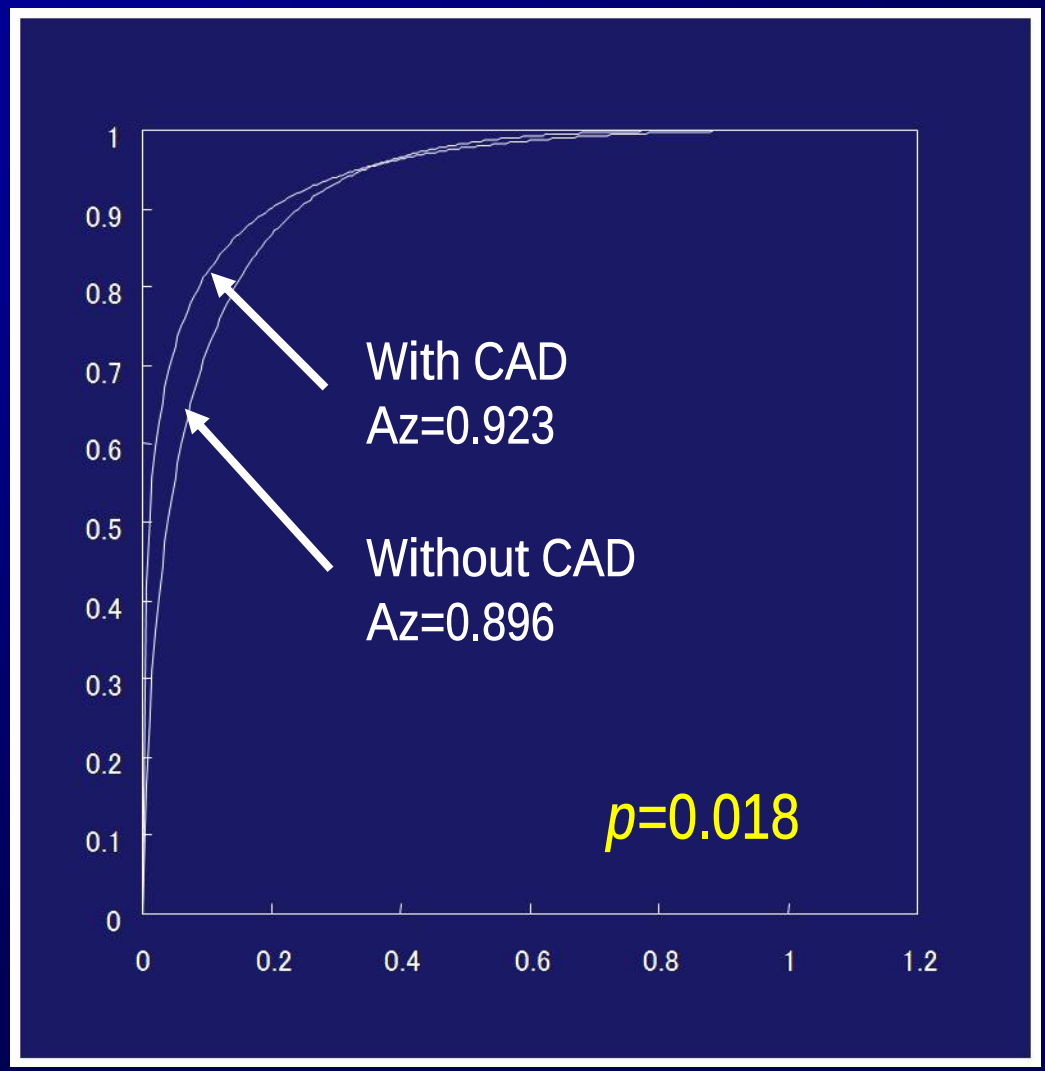
HRCT

Performance in Kyushu University Hospital

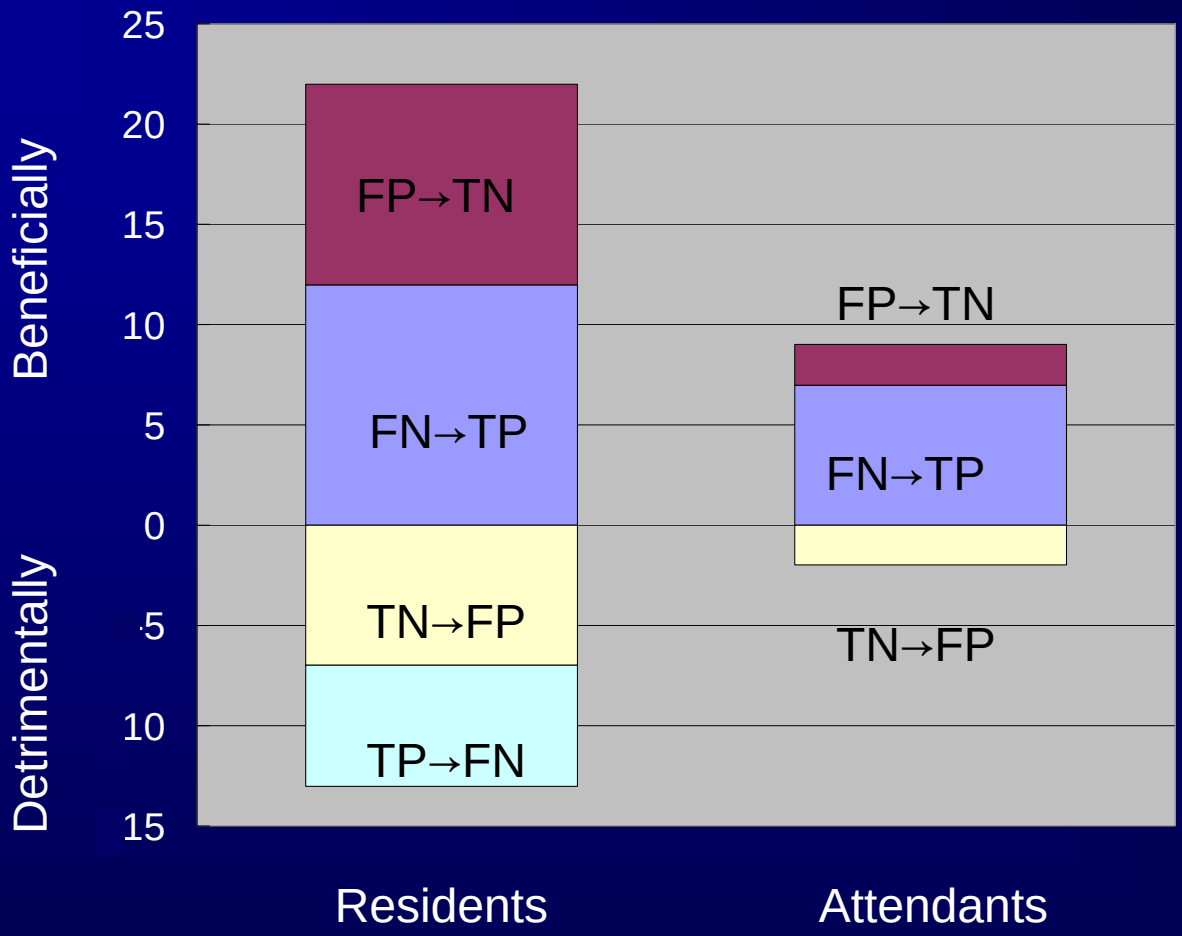
- The overall detectability of the computer aided nodule detection system was 37/50 (74%) for consecutive T1 cases with resectable lung cancer.
- The false-positive rate for lung cancer and normal cases was 2.04 and 2.28 false positives per case, respectively.

Sakai S, et al. J Digit Imaging 2006

The mean Az value of all observer



The relevant change in confidence levels

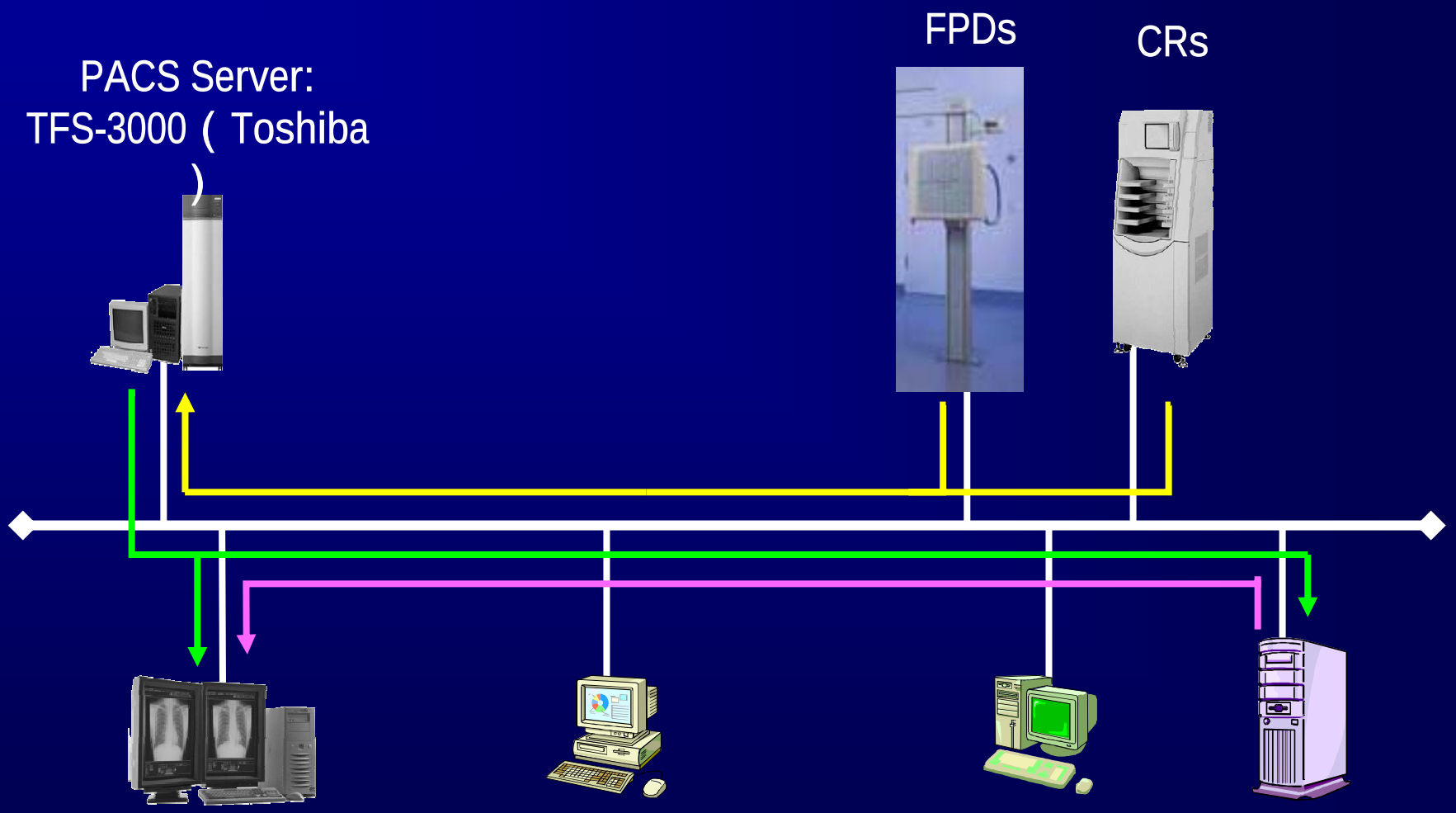


TP: True Positive TN: True Negative FP: False Positive FN: False Negative

Clinical Practice in Kyushu University Hospital

- For routine interpretation, we began to use temporal subtraction images since January 2001 and nodule detection images since May 2002.
- The CAD system was integrated Into PACS.
- Loading style of CAD Images has been changed conventional DICOM protocol into Web browser type in 2007.

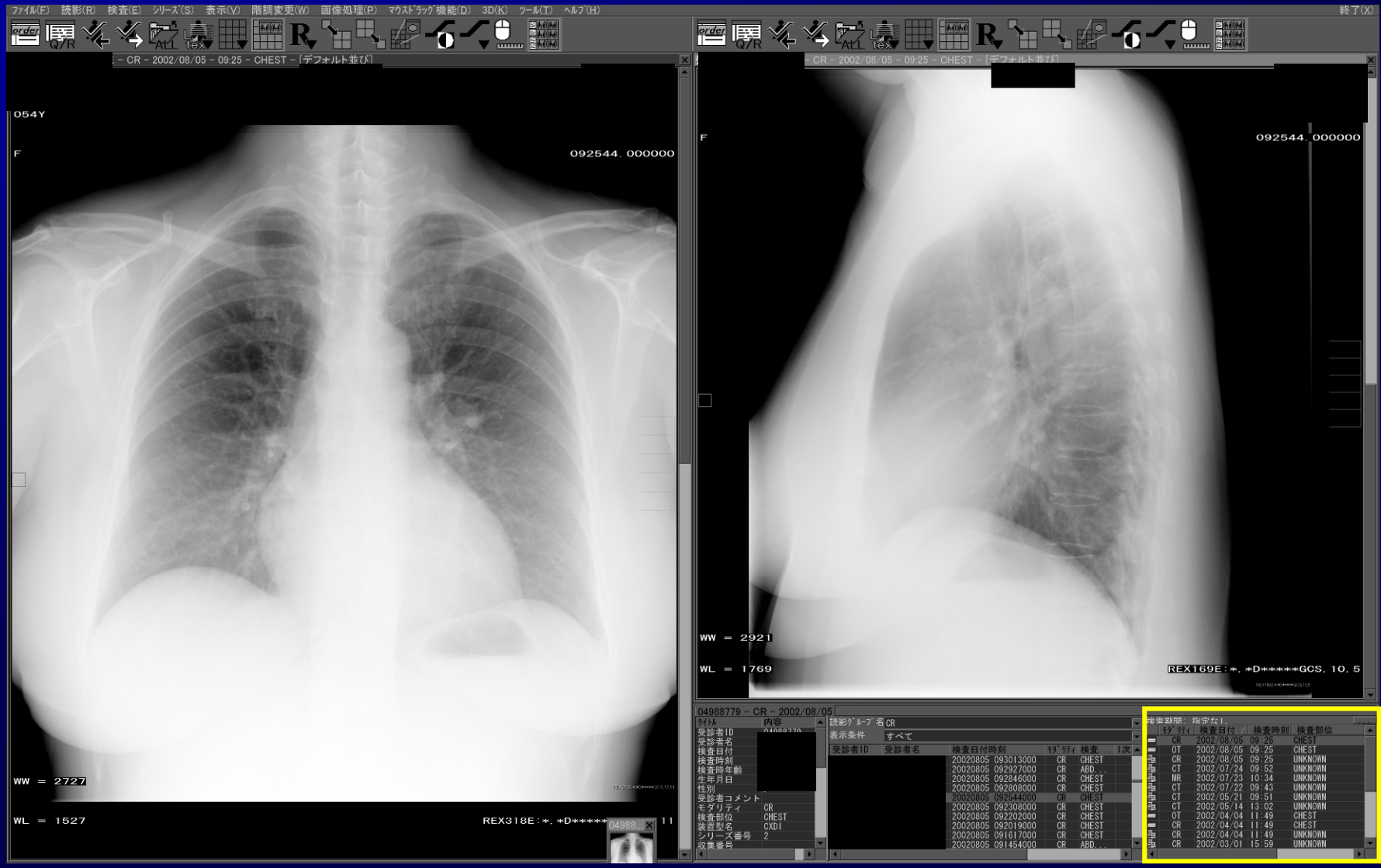
Previous method of Integration into PACS



Reporting System:
PC-CIS (IBM)

Workstation
：DICOM Viewer
TWS-2500 (Toshiba)

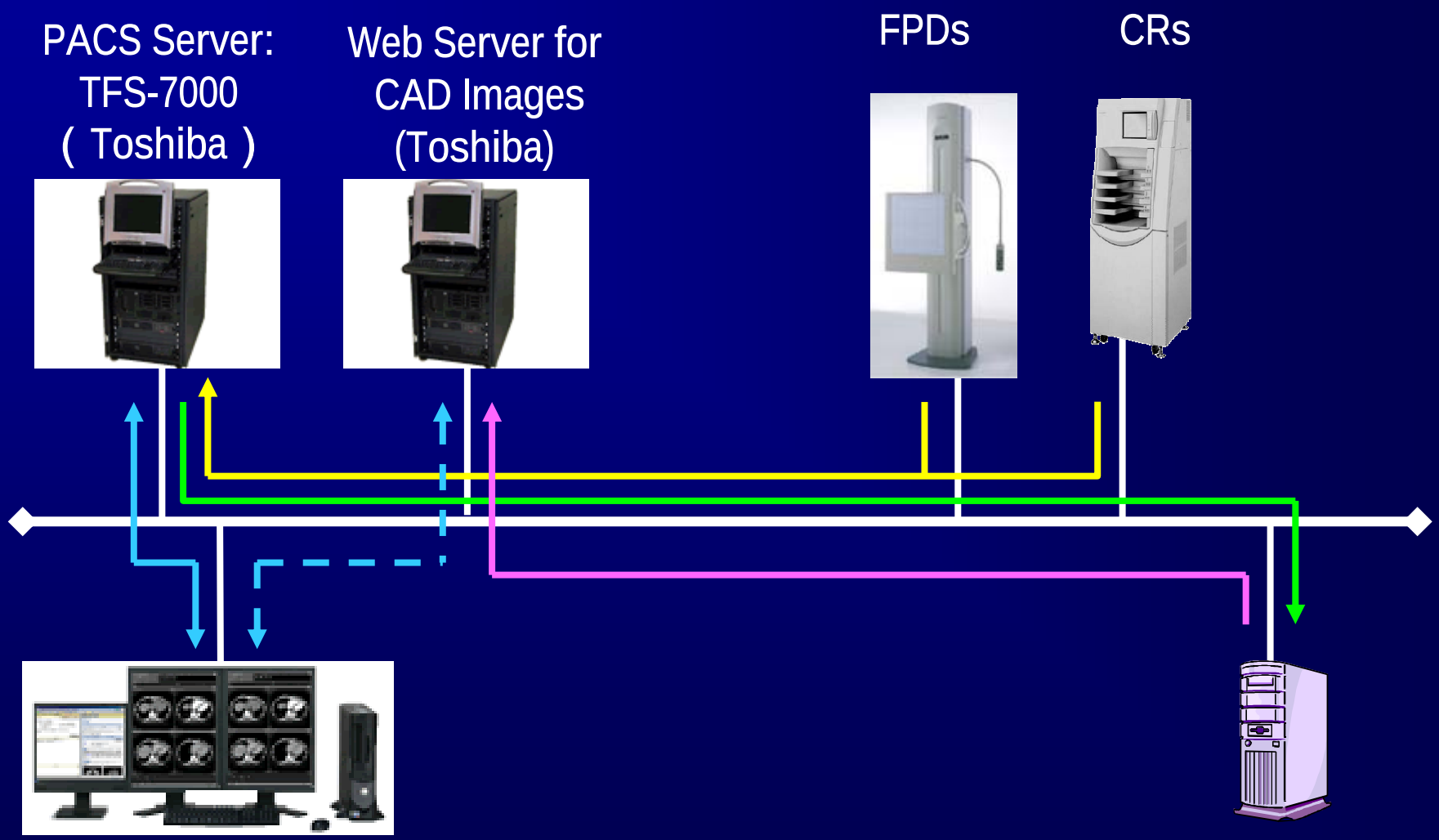
Work Flow of Interpretation

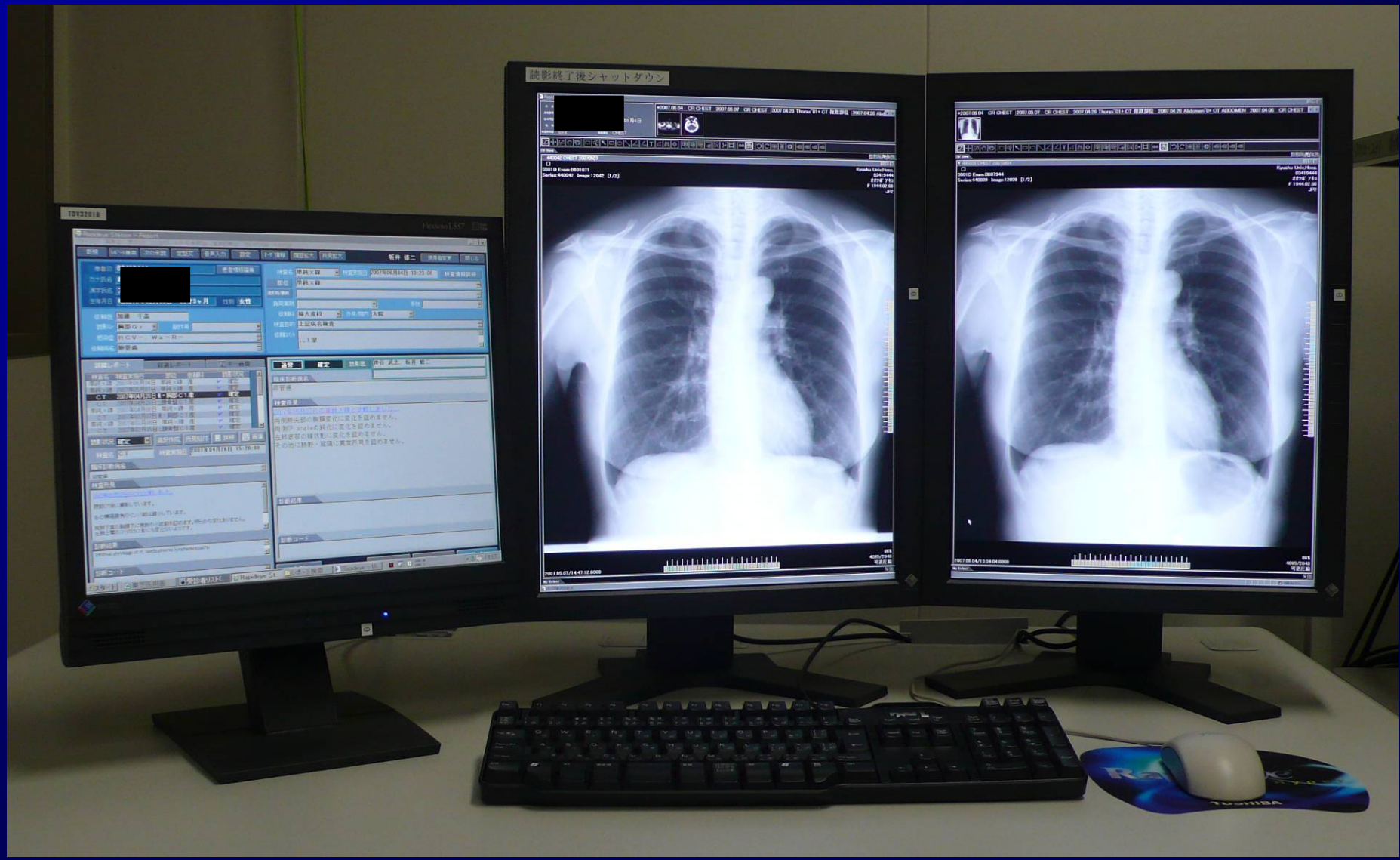


Enlarged previous examination list

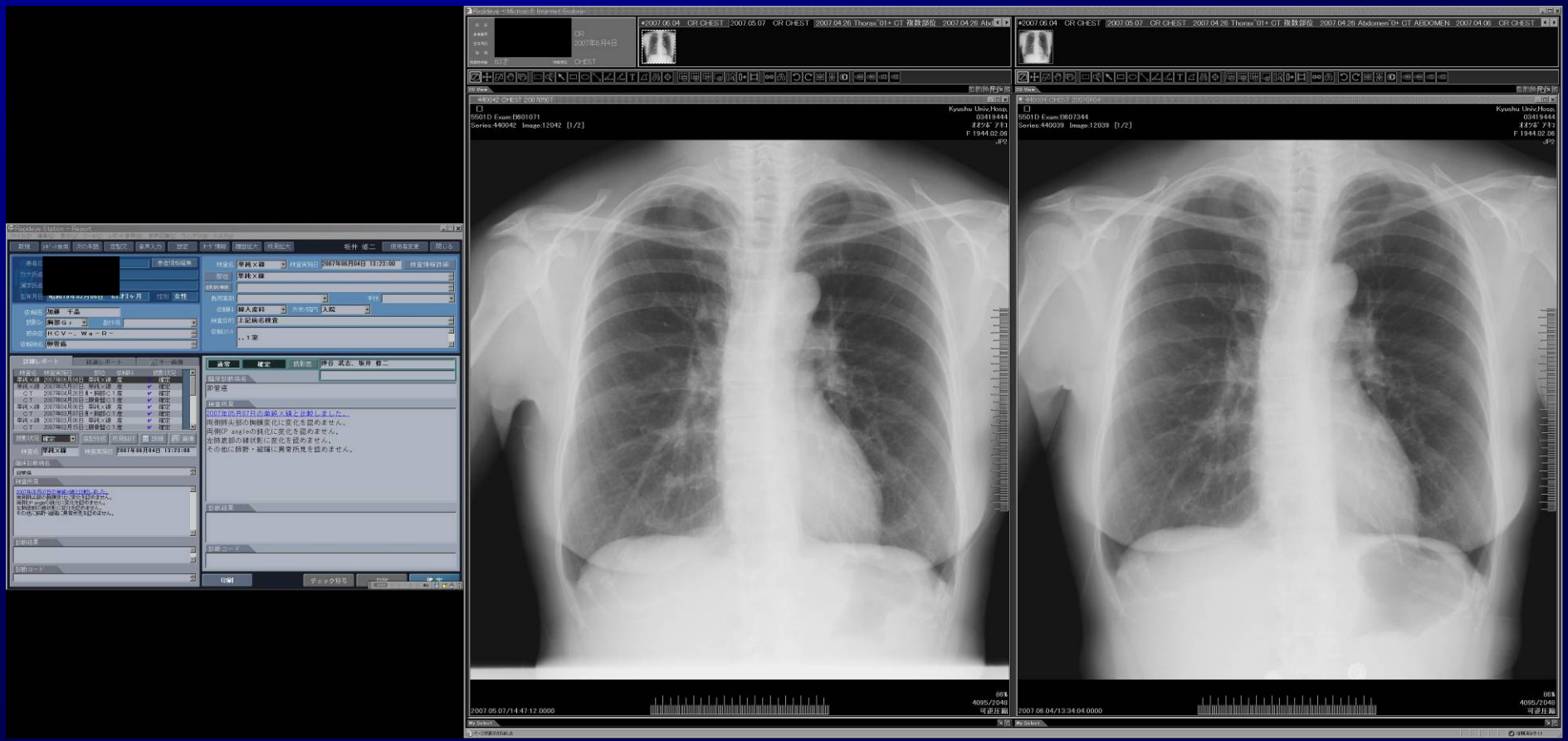
Comparative Interpretation referring to CAD images

Present method of Integration into PACS





Workstation with Reporting System
Rapid Eye (Toshiba)


Rapideye Station - Report
坂井 修二
検査名 単純Ｘ線
検査実施日 2007年05月04日 13:23:00
部位 単純Ｘ線
依頼元 加藤 千晶
依頼科 胸部Ｇｒ
依頼医 ＨＣＶ－，Ｗａ－Ｒ－
依頼科名 膠原病
検査目的 上記病名検査
依頼コメント ．．１家
詳細レポート
検査レポート
キー画像
通常
確定
読影医 神谷 武志，坂井 修二
臨床診断病名
肝膿瘍
検査所見
2007年05月07日の単純Ｘ線と比較しました。
両側肺尖部の陰影変化に変化を認めません。
右側CP angleの鈍化に変化を認めません。
左肺実質の線状影に変化を認めません。
その他に肺野・縦隔に異常所見を認めません。
診断結果
診断コード
印刷
チェック待ち
Rapideye - Microsoft Internet Explorer
CR
2007年6月4日
CHEST
2007.05.04 CR CHEST 2007.05.07 CR CHEST 2007.04.26 Thorax^01+ CT 複数部位 2007.04.26 Abd
2007.06.04 CR CHEST 2007.05.07 CR CHEST 2007.04.26 Thorax^01+ CT 複数部位 2007.04.26 Abdomen^01+ CT ABDOMEN 2007.04.06 CR CHEST
2D View
440042 CHEST 20070507
55010 Exam:0601071
Series:440042 Image:12042 [1/2]
Kyushu Univ.Hosp.
03419444
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F 1944.02.06
JP2
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4095/2048
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2007.05.07/14:47:12.0000
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55010 Exam:0607344
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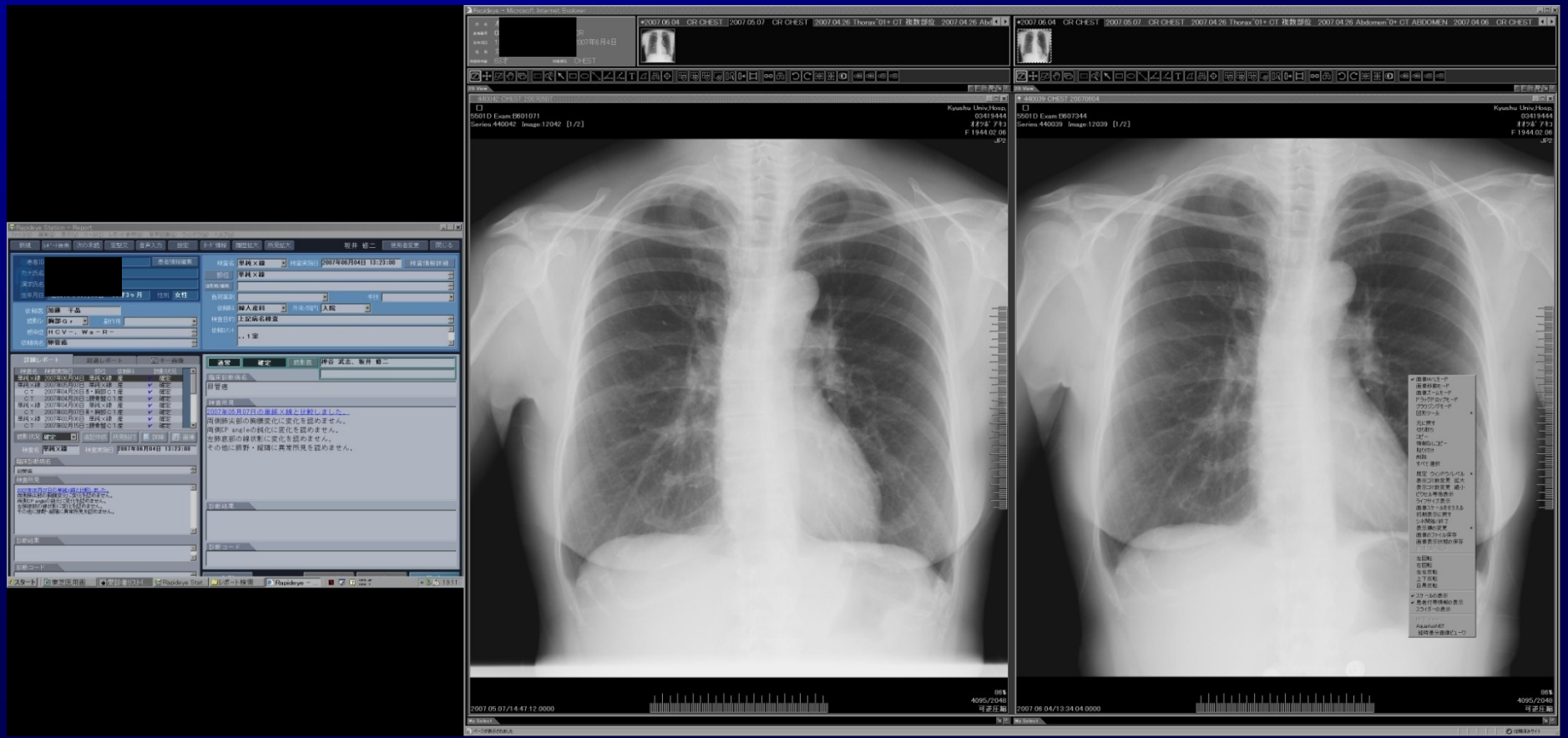
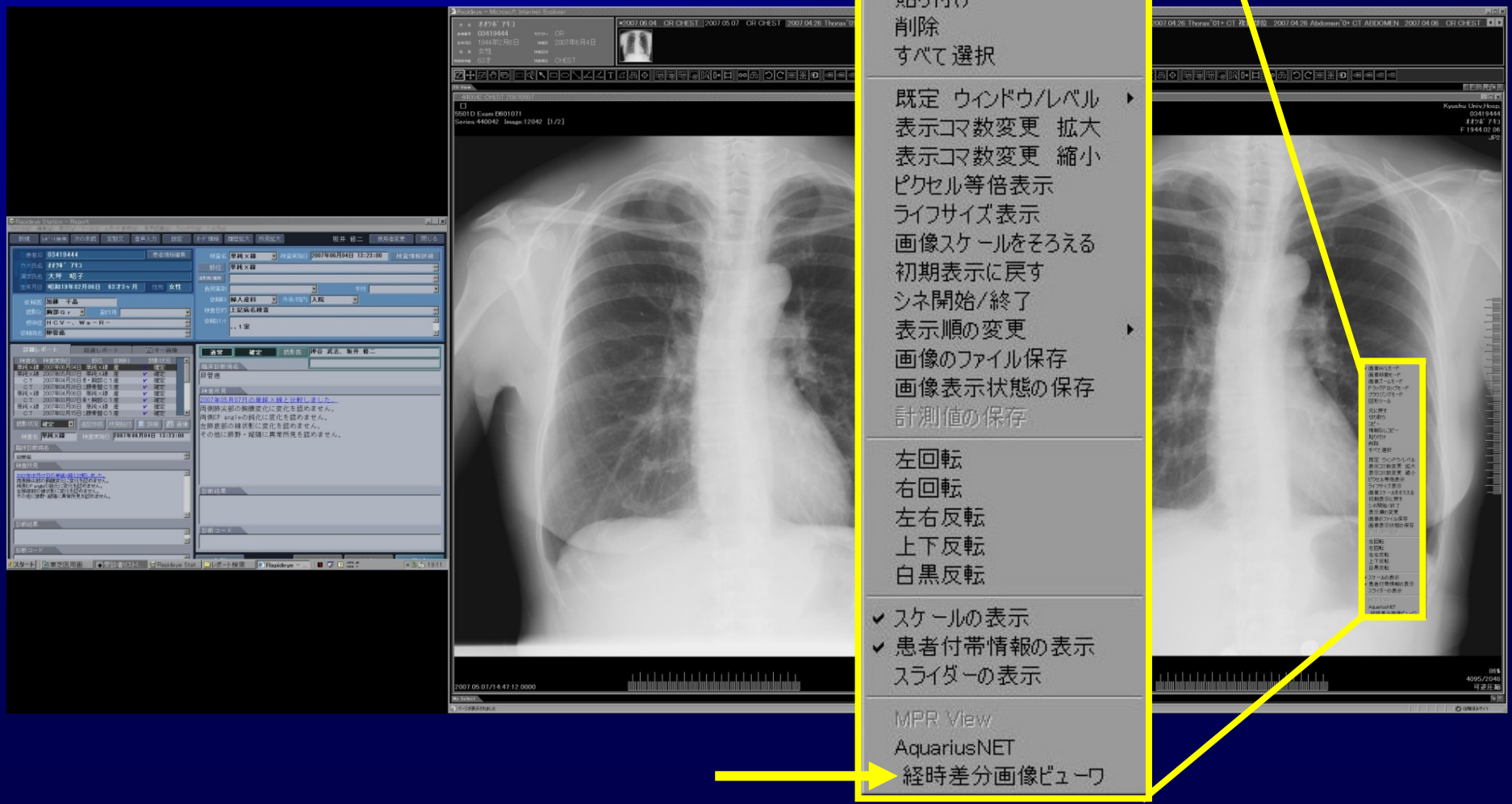
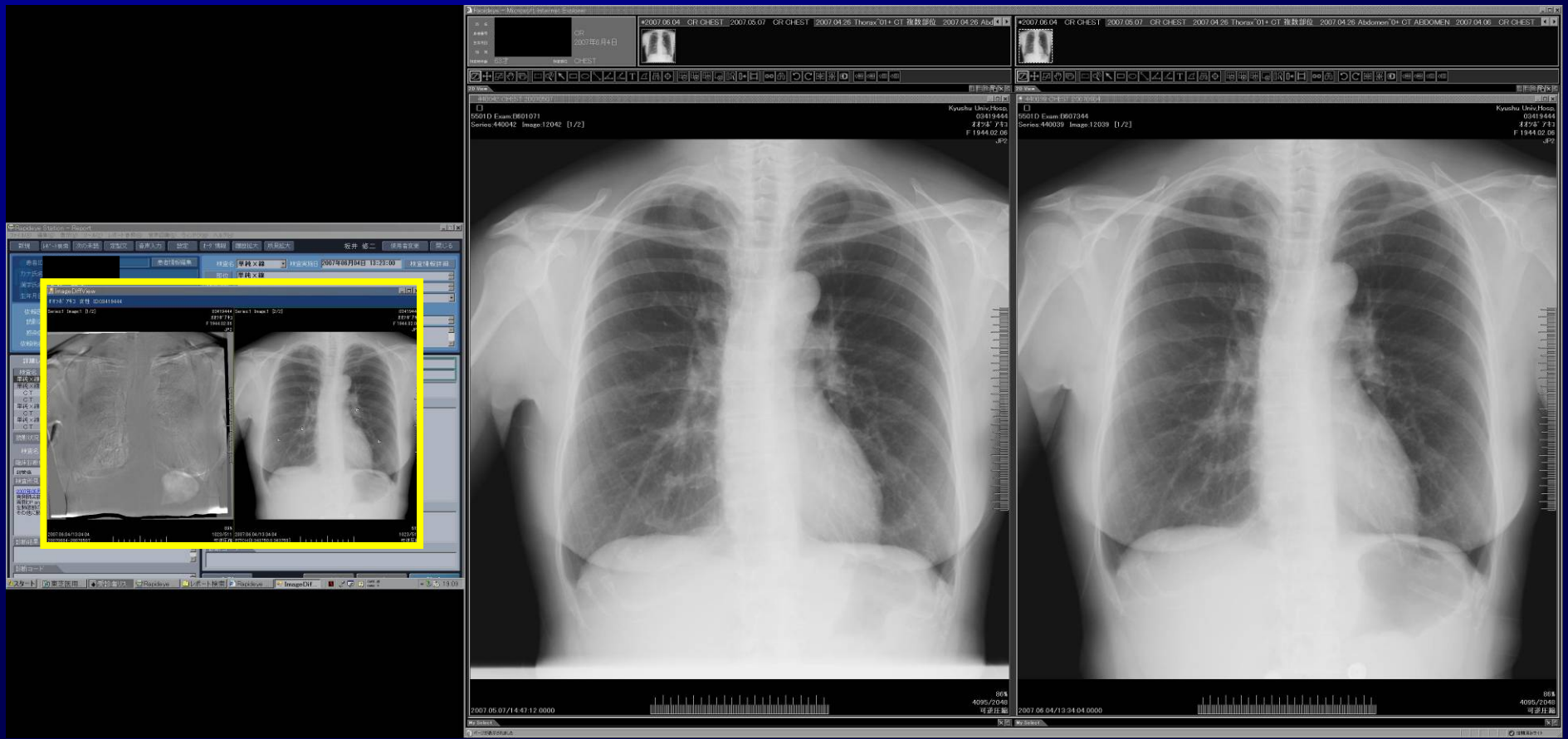
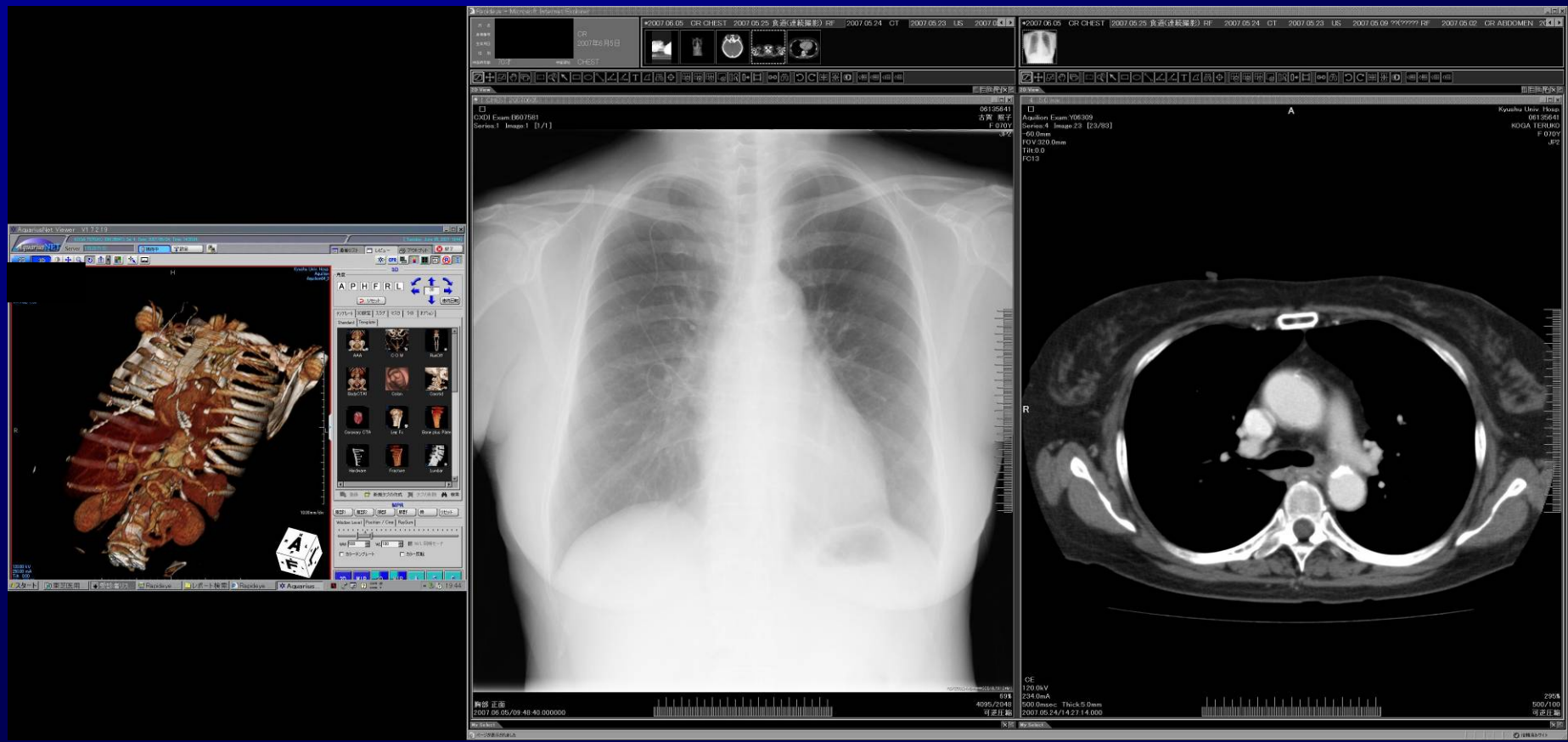
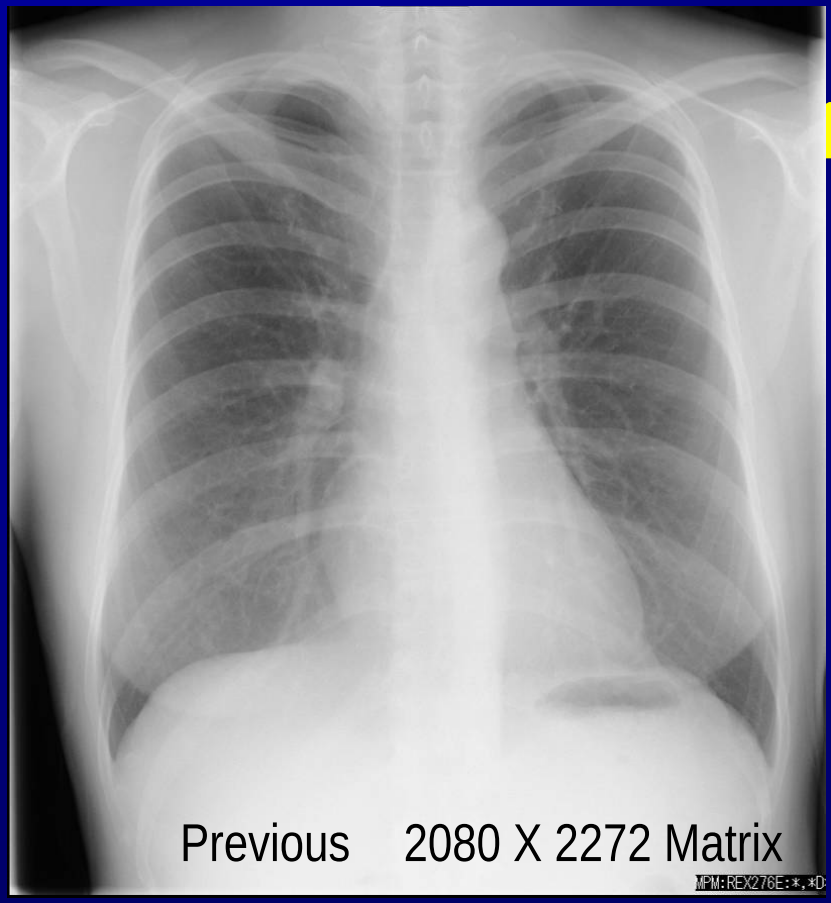
2007.06.04/13:34:04.0000
My Select

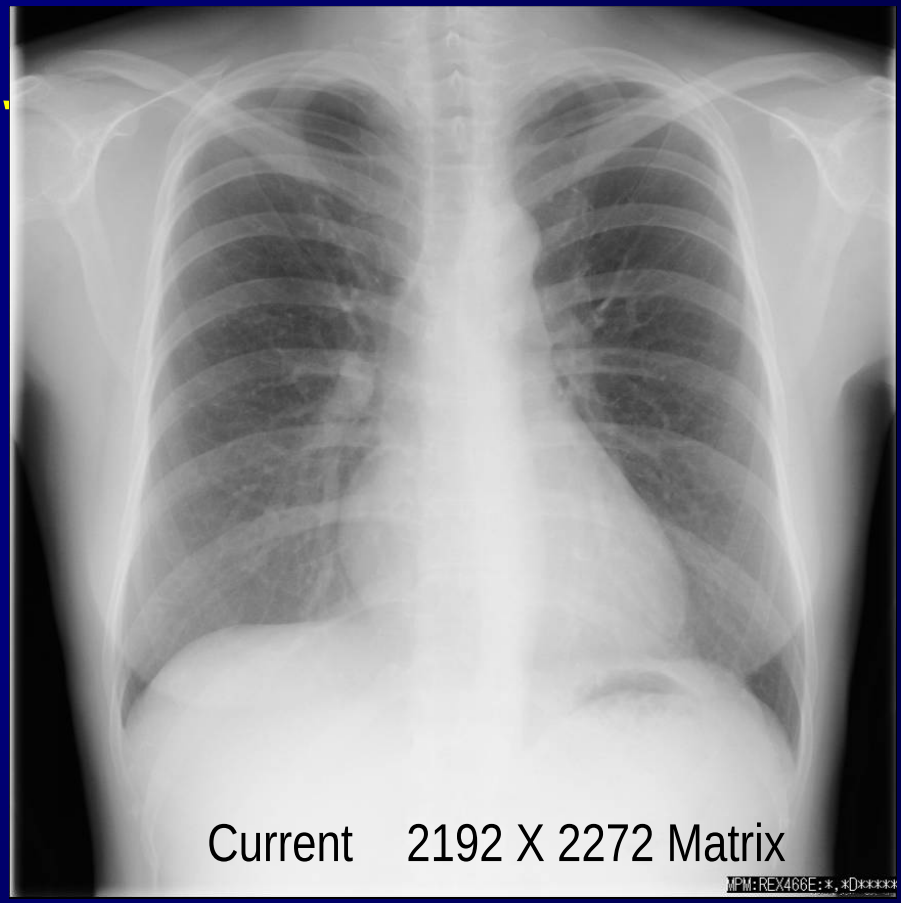



画像W/Lモード
画像移動モード
画像ズームモード
ドラッグドロップモード
ブラウジングモード
図形ツール
元に戻す
切り取り
コピー
情報なしコピー
貼り付け
削除
すべて選択
既定 ウィンドウ/レベル
表示コマ数変更 拡大
表示コマ数変更 縮小
ピクセル等倍表示
ライフサイズ表示
画像スケールをそろえる
初期表示に戻す
シネ開始/終了
表示順の変更
画像のファイル保存
画像表示状態の保存
計測値の保存
左回転
右回転
左右反転
上下反転
白黒反転
スケールの表示
患者付帯情報の表示
スライダーの表示
MPR View
AquariusNET
経時差分画像ビューワ

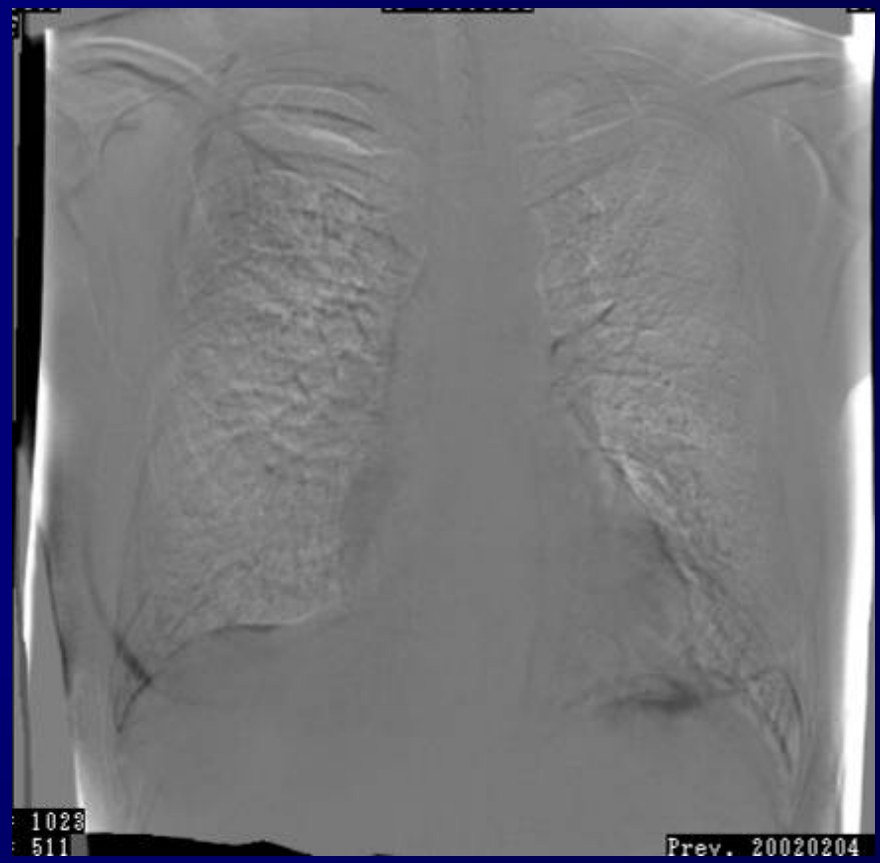








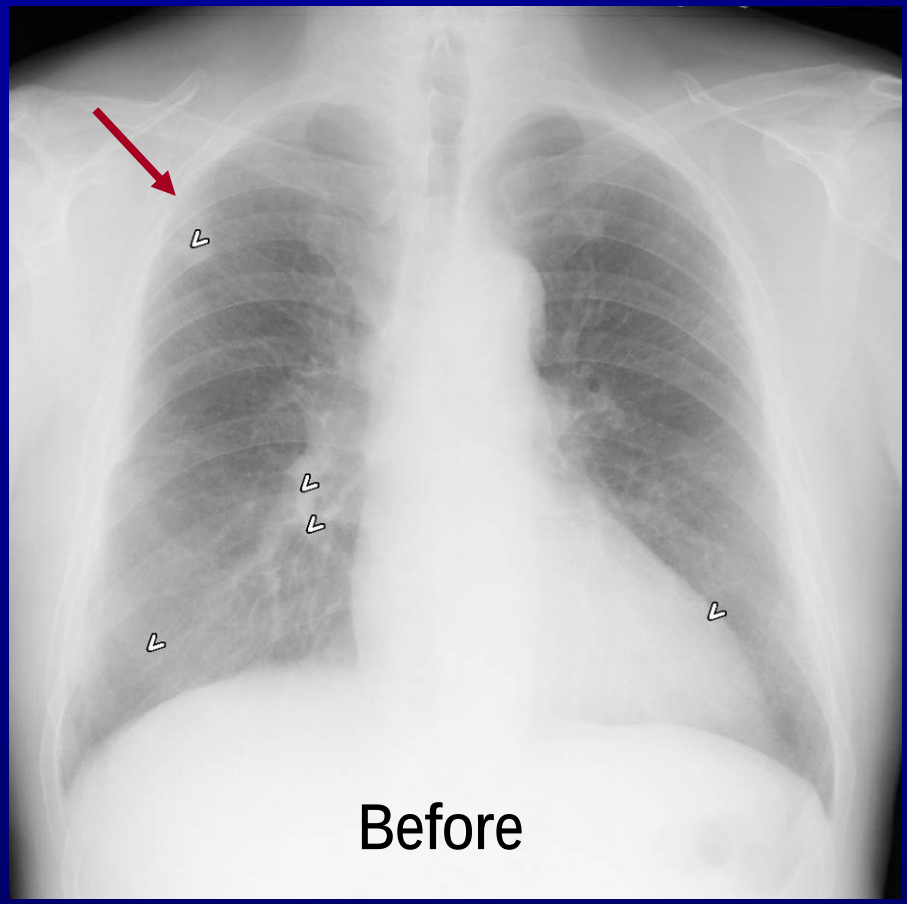
In this case, original chest radiographs were obtained with CXDI-11. These matrix sizes were different according to the collimation size. Image quality of temporal subtraction image was improved with by use of an upgraded computer algorithm.

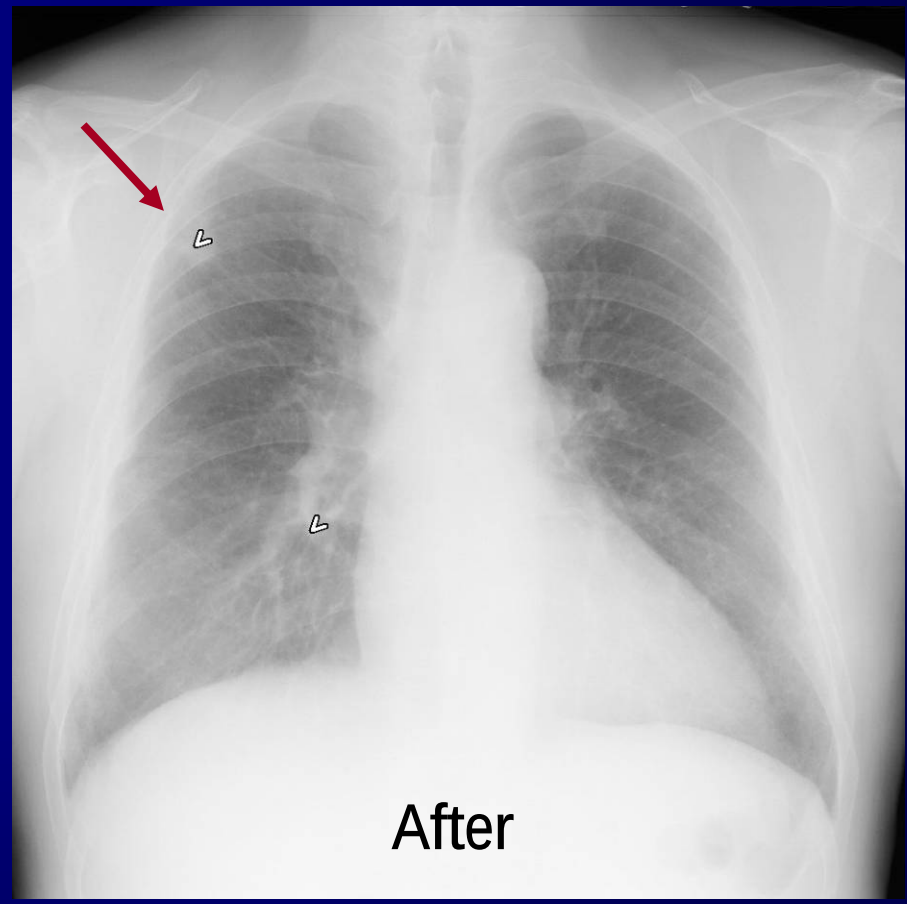


Before

After

Image quality of temporal subtraction image was improved with by use of an upgraded computer algorithm.





In this case, nodule detection image with the previous version showed five candidate for pulmonary nodule. Among them, a candidate is true positive for lung cancer (red arrow). After improving the computer algorithm, the number of false positive was decreased from four to one .

Sakai S. et al. J Digit Imaging, 2008

Conclusion

- We had integrated temporal subtraction and nodule detection systems into hospital's PACS.
- We faced some problems to integrate the CAD system to hospital's PACS.
- We had changed loading style of CAD images from conventional DICOM protocol to web browser type.
- In the upright position, temporal subtraction images were acceptable quality for clinical use.
- The overall detectability of the nodule detection system was 74% and the false-positive rate was 2.1 false positives per case.

Thank You very much for Your Attention !