

COMPARISON OF CHEST-MRI TO CHEST-CT TO MONITOR CYSTIC FIBROSIS LUNG DISEASE

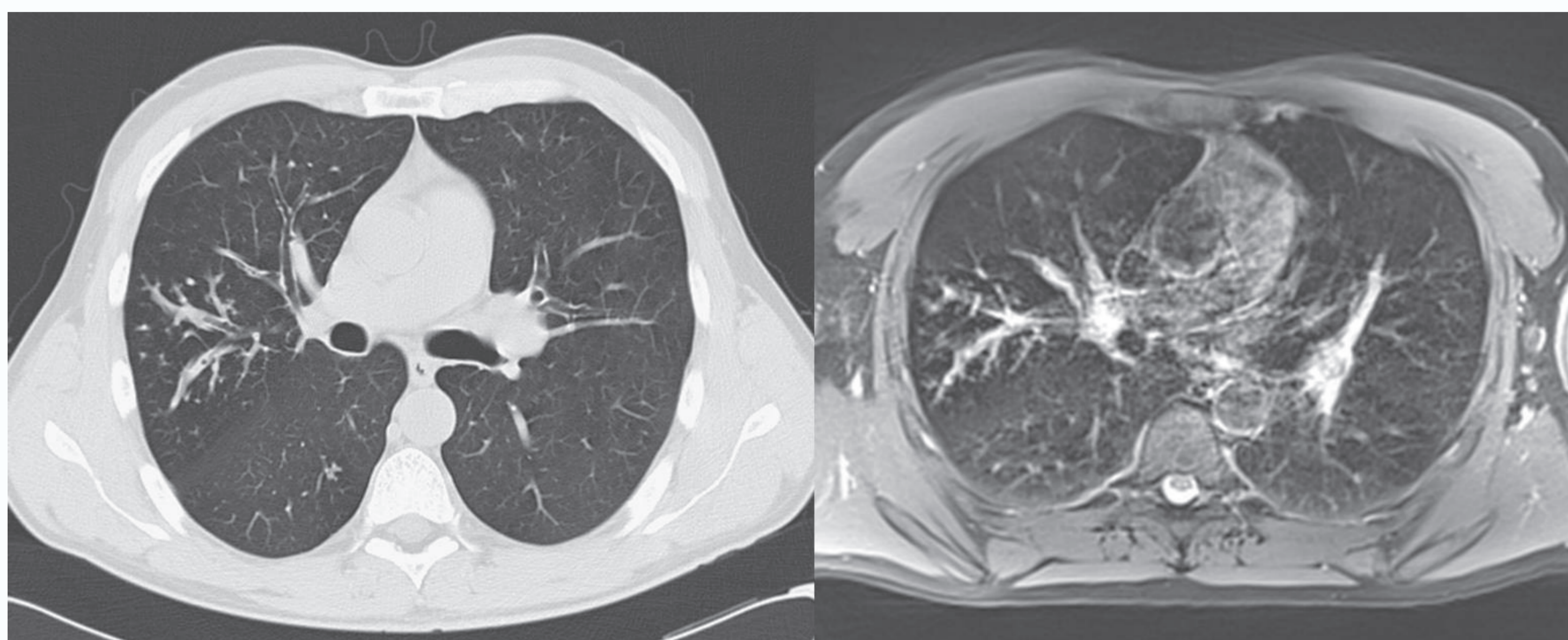


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BACKGROUND

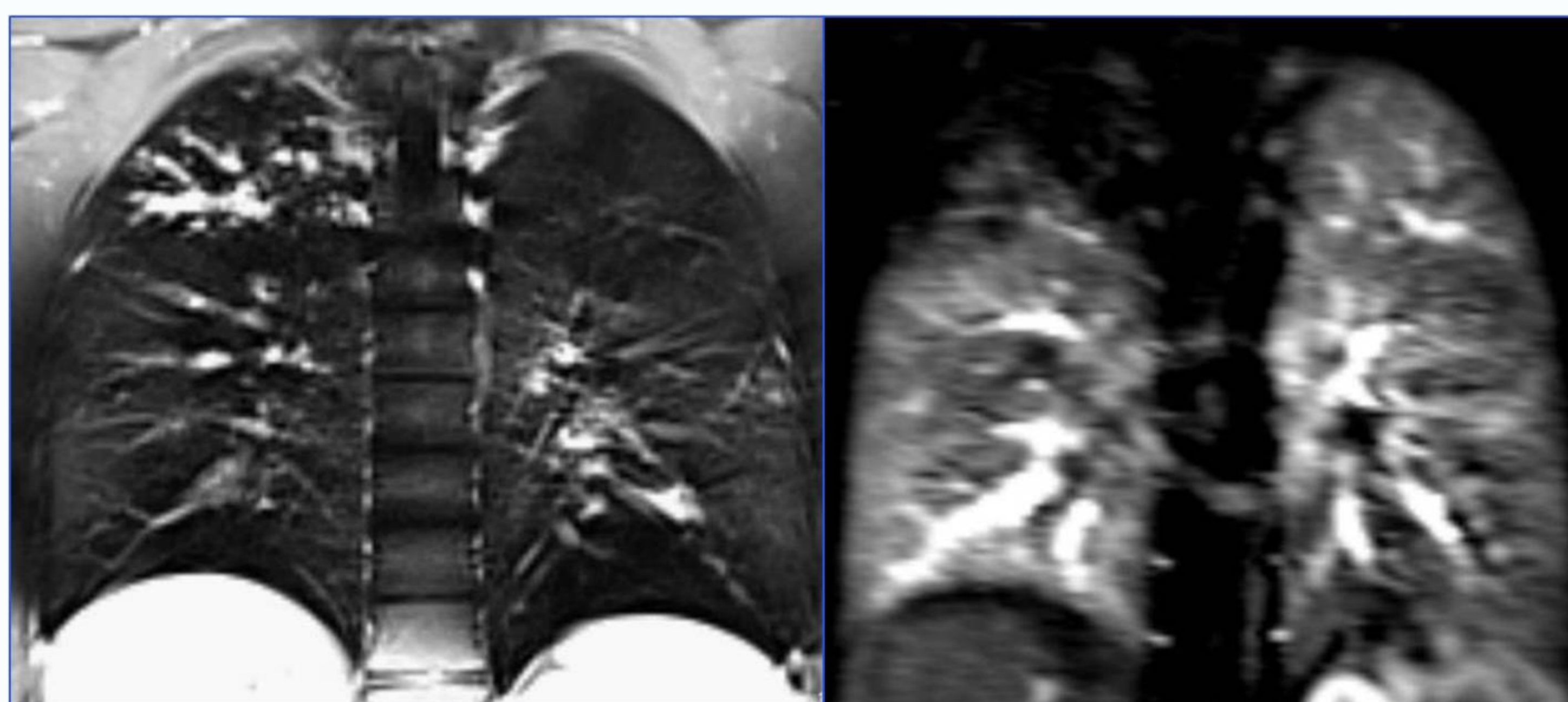
The most important components of CF lung disease are bronchiectasis (BE) and trapped air (TA). Chest-CT is the current gold standard to diagnose and monitor BE, TA and other structural lung alterations in CF. Chest-MRI has been suggested as a radiation free alternative for CT, but it's limited by a lower spatial resolution, especially in the lung periphery[1].



CT (image on the left) and MRI of the same patient and at the same level.

PURPOSE: To compare the sensitivity of Chest-CT and Chest-MRI to detect BE and TA in CF.

MATERIALS AND METHODS



DP-W coronal view and PWI (Perfusion Weighted Imaging), note in the RUL the area of mucous plugging (left image) that correspond to a perfusion defect (images on the right)

- Two centres study: Treviso and Rome (Italy), data analysis in Rotterdam (Netherlands).
- 38 stable CF patients (22 females; mean age 22.7 yrs, range 6-51 yrs) had a low-dose CT and MRI performed on the same day.
- MRI studies: (1.5 T scanner Avanto Siemens, Enlargen, Germany) acquisition protocol: respiratory triggered T2-W BLADE sequence (TR: 2000; TE: 27; FOV: 400 mm; flip angle: 150; slice thickness 5 mm) acquired on axial and coronal plane; Perfusion Weighted Imaging (PWI) and Diffusion-Weighted Imaging (DWI).
- CT: (64-row scanner Somatom Siemens, Enlargen, Germany) KV 120; mAs 20-40; collimation: 1 mm; slice thickness: 1 mm; end inspiration and end expiration.
- CTs and MRIs were anonymized and scored in random order by 2 independent observers using the validated CF-CT score (Brody II)[2] and an equivalent CF-MRI scoring system. BE, TA and other structural components were scored. All scores were expressed as % of the maximal score. Mean scores of both observers were used for comparisons between CT and MRI scores.
- Statistical Analysis: Pearson; Intra Class Coefficient (ICC); Bland-Altman plots; results mean (range)

Acknowledgements

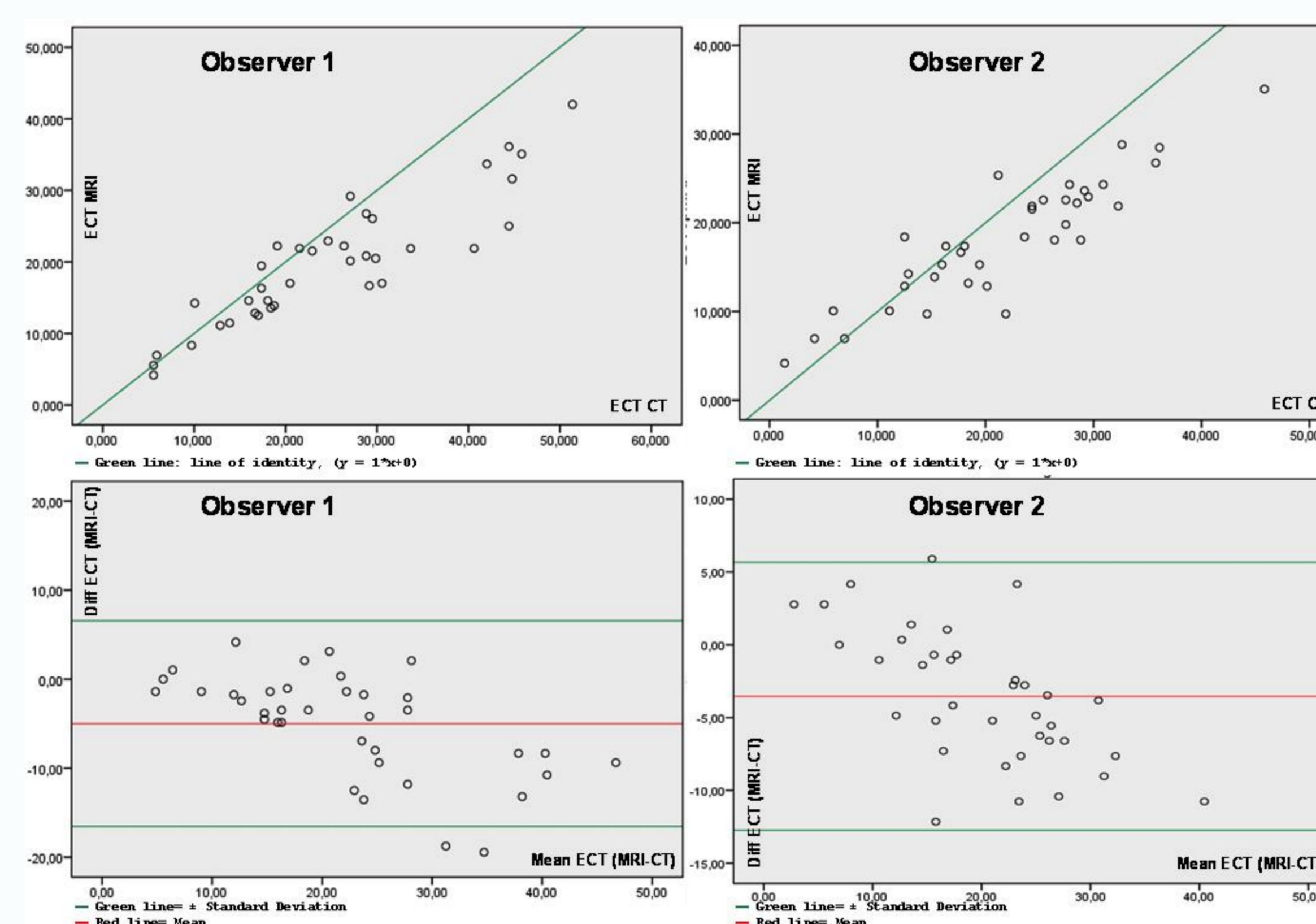
This study was supported by a grant by CF Center Verona and Italian Cystic Fibrosis Association

References

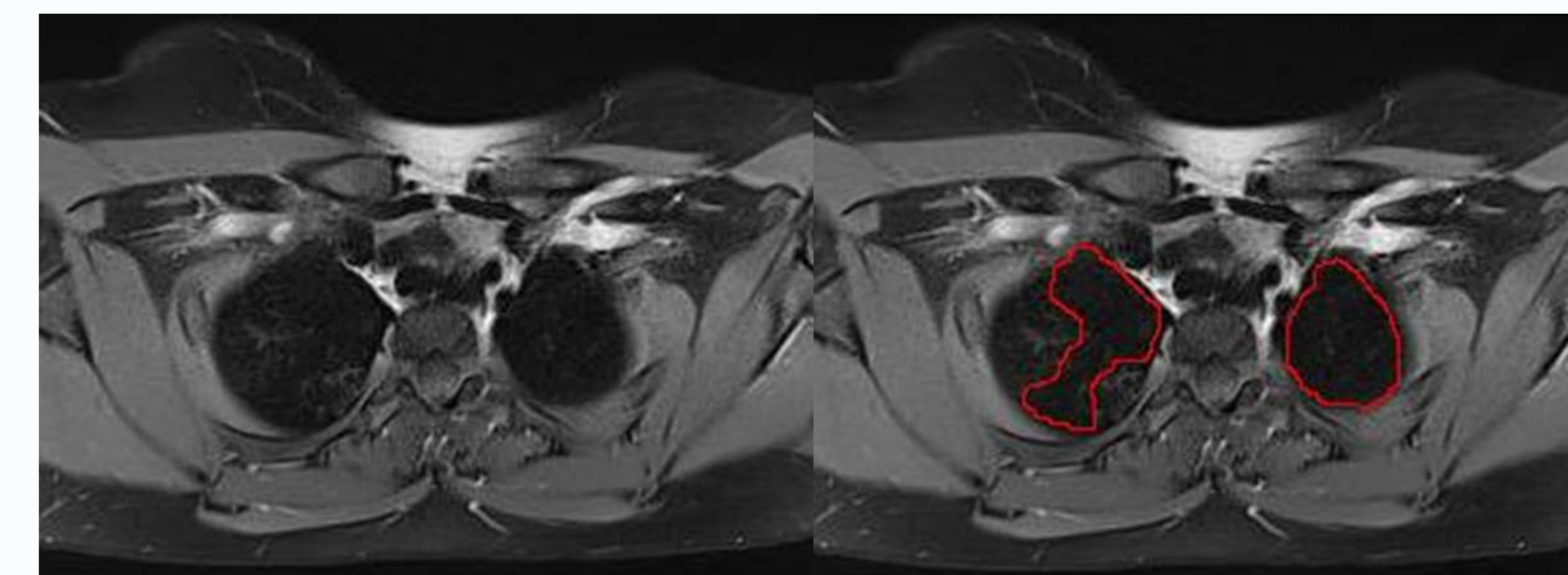
- [1] Lung morphology assessment using MRI: a robust ultra-short TR/TE 2D steady state free precession sequence used in cystic fibrosis patients. Failo R. et al. Magn Reson Med. 2009 Feb;61(2):299-306
- [2] Reproducibility of a scoring system for computed tomography scanning in cystic fibrosis. Brody AS et al. J Thorac Imaging. 2006 Mar;21(1):14-21
- [3] Assessment of morphological MRI for pulmonary changes in cystic fibrosis (CF) patients: comparison to thin-section CT and chest x-ray. Puderbach M et al. Invest Radiol. 2007 Oct;42(10):715-25

RESULTS

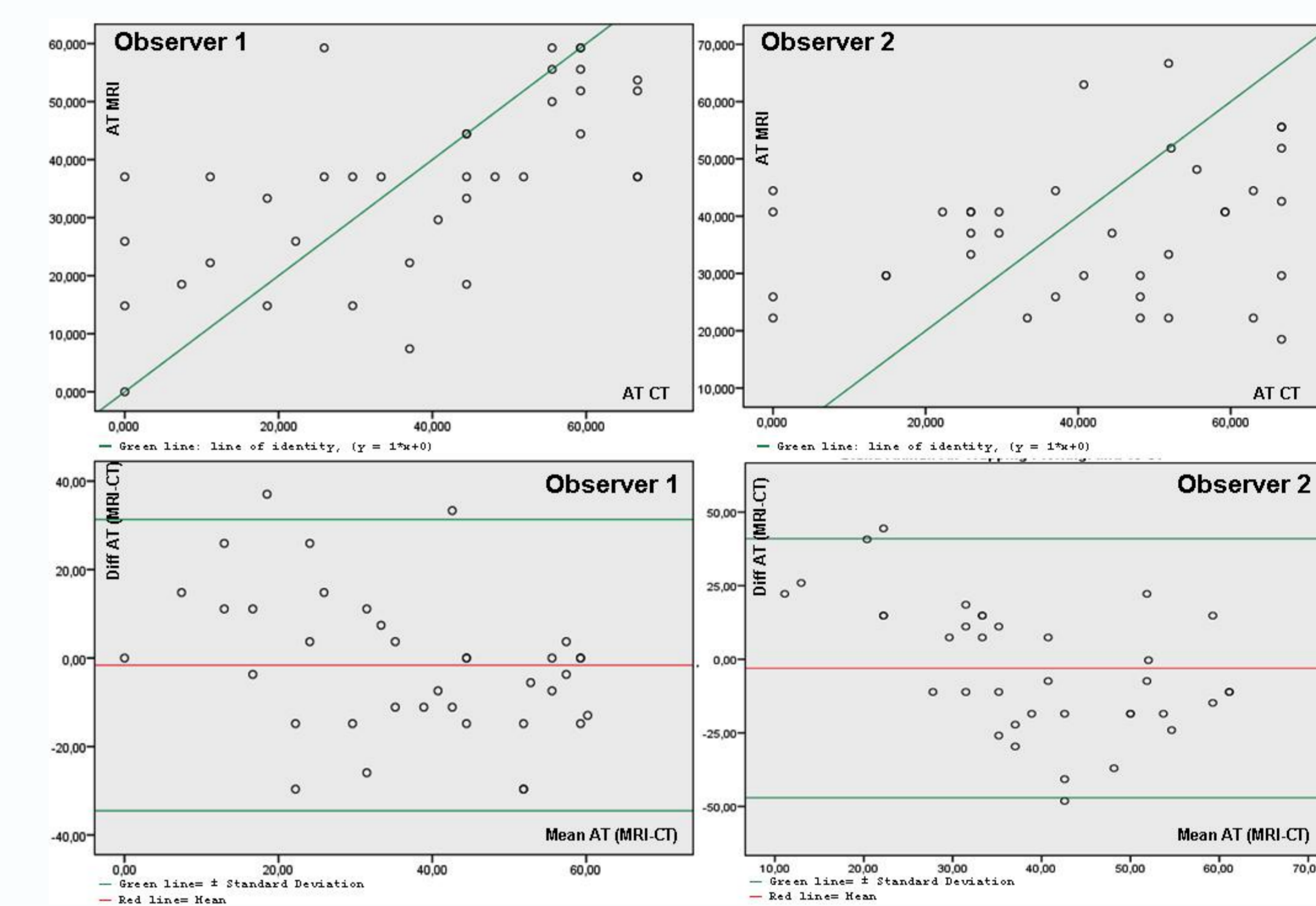
- ICC CT-BE (0,931); MRI-BE(0,892); CT-TA (0,917); MRI-TA (0,677).
- Correlation between CT-BE score and MRI-BE score (R=0,940, p=0,0001); between CT-TA and MRI-TA (r=0,511, p=0,005).
- Bland-Altman plots showed that MRI systematically overestimated severity of BE compared to CT in mild CF lung disease and underestimate in severe cases.
- The intra-observer variability was ICC CT-BE (0,925), CT-TA (0,966); MRI-BE (0,838), MRI-TA (0,819).



In the Upper row Identity-Plots, in the lower row the correspondent Bland-Altman Plots for each Observer (right and left columns) for Bronchiectasis (ECT) score. (MRI= Magnetic Resonance Imaging; CT= Computed Tomography, Diff (Difference) ECT= bronchiectasis MRI-bronchiectasis CT scores; Mean ECT= [Bronchiectasis MRI score + Bronchiectasis CT score]/2). Note as the dots cross the line of identity (green lines in upper row), which means that MRI overestimates mild CF lung disease and underestimate severe cases compared to CT.



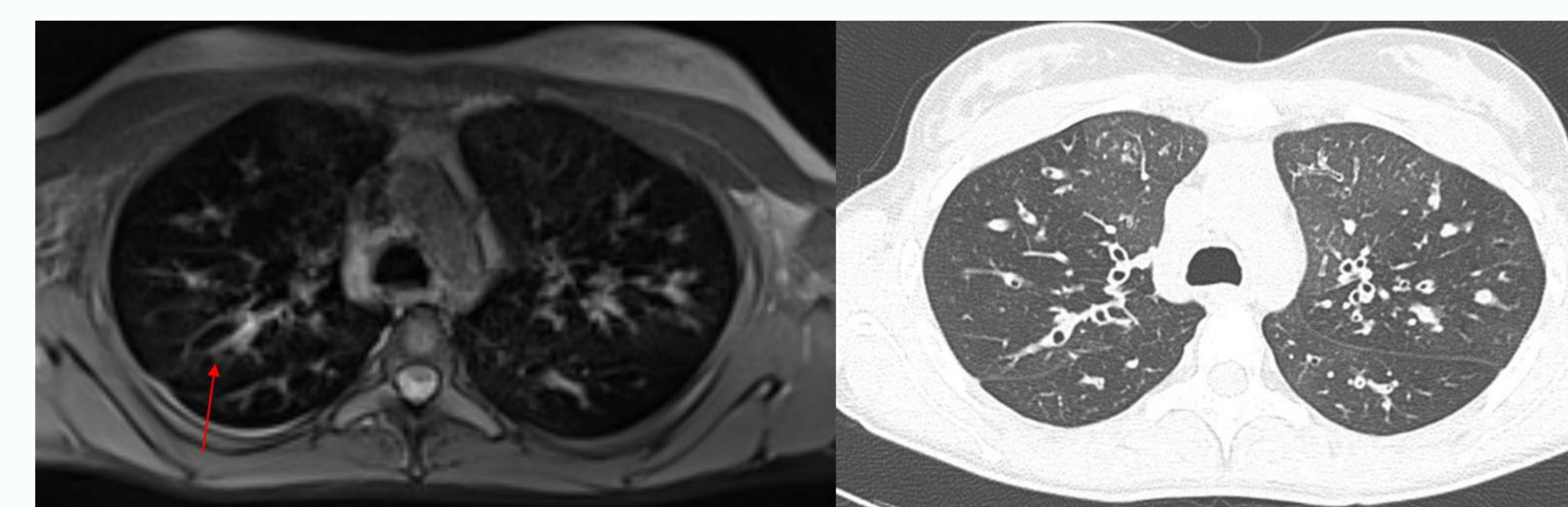
DP-W axial view of the upper lobes. Note the lack of signal (darker zones bordered by the red lines) due to the inhomogeneities of the magnetic field



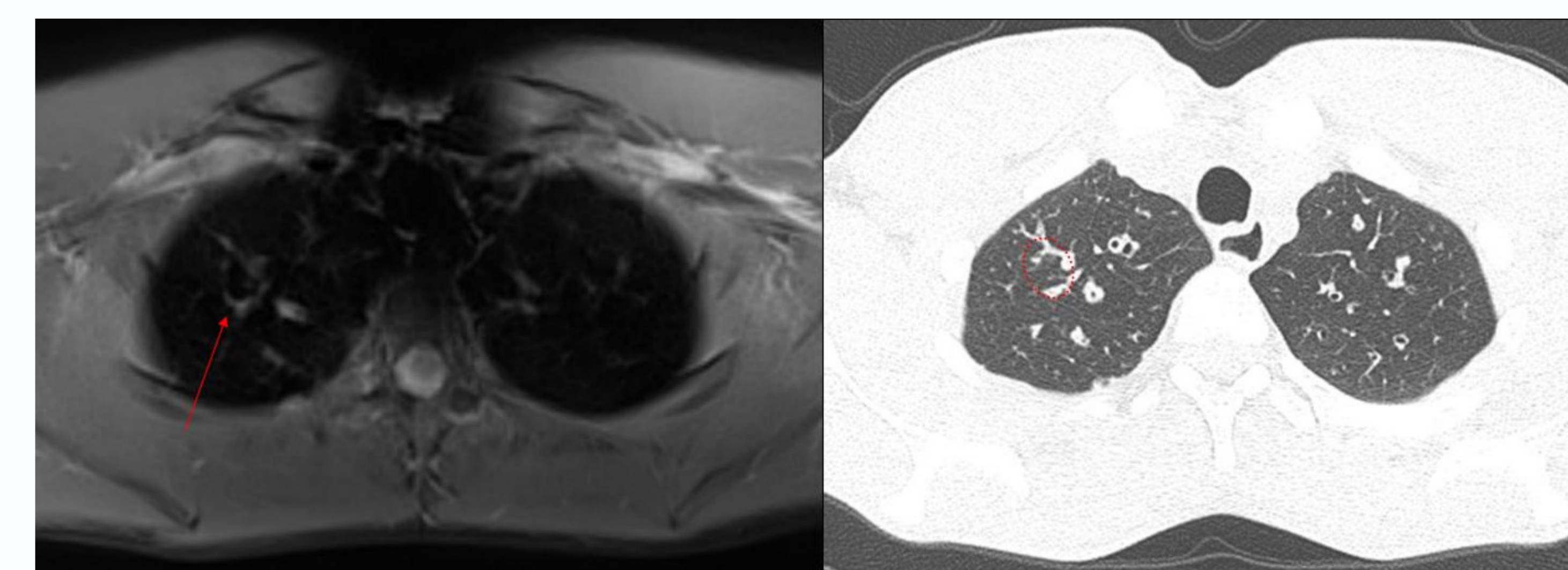
In the Upper row Identity-Plots, in the lower row the correspondent Bland-Altman Plots for each Observer (right and left columns) for Air Trapping (AT) score. (MRI= Magnetic Resonance Imaging; CT= Computed Tomography, Diff (Difference) AT= AT MRI - AT CT scores; Mean AT= [AT MRI score + AT CT score]/2). Note the dispersion of the dots around the line of the identity (green lines in upper row) for both observers that underlines the lower reliability (lower ICCs) of MRI on Air Trapping assessment compared to CT.

DISCUSSION

- Our result show that the MRI is less accurate than CT in the CF assessment.
- Both observer obtained the same result in scoring the batch of MRI.
- Bland Altman plots underlined as for mild CF lung alterations the MRI tends to overestimate compared to CT. Differently in severe CF lung disease the MRI leans towards lower scores compared to CT.
- Despite last improvement in the MRI field, CT has still a higher resolution in particular for the periphery of the lung.



DP-W axial view and correspondent CT image. The red arrow indicates a false image of Bronchiectasis in the MRI due to a vessel's disposition.



DP-W axial view and correspondent CT image. The red arrow indicates a false image of a big Bronchiectasis in the MRI (left image) that should be in the zone bordered by the dashed line.

CONCLUSION

- Although Chest-MRI represents a promising radiation-free alternative to CT to monitor CF lung disease, our study demonstrated that MRI is less sensitive compared to CT in the detection of BE and TA, differently that has been stated in previous studies [3].
- We are currently improving our protocol and testing alternative image analysis techniques to improve the sensitivity of MRI to monitor CF lung disease.

