

Background & objectives

Neuromelanin-sensitive MRI (NM-MRI) is a candidate non-invasive marker of dopaminergic neuron integrity in the substantia nigra (SN) [1-4]. Magnetisation transfer gradient echo (MT-GRE) uses explicit MT preparation; T1-weighted turbo spin echo (TSE) relies on T1-weighting and implicit MT effects [5-7].

Objectives: Compare MT-GRE and TSE sequences in terms of contrast ratio (CR), propose an SN-segmentation-free framework for CR measurement, and assess whether the observed MT-GRE–TSE contrast difference is reproduced using anatomically segmented SN and crus cerebri (CC) regions.

Materials & methods

Study design

Three healthy volunteers were scanned on a 3T GE SIGNA Premier scanner using a 48-channel head coil, with both 2D sequences acquired in an oblique axial plane.

Matched acquisition settings

In-plane resolution: $0.687 \times 0.687 \text{ mm}^2$; matrix: 320×320 ; phase FOV: 75%; five averages. Whole-brain T1w: $1 \times 1 \times 1 \text{ mm}^3$ for anatomical reference.

Parameter	MT-GRE	TSE
TE / TR (ms)	4.5 / 450	11.5 / 890
Flip angle	40°	90° / 180°
Slice thickness	1.5 mm	3 mm
Number of slices	16	10
Repetition (scan time)	5 Rep (~9 min)	5 Rep (~7.5 min)

SN-segmentation-free framework

Preprocessing included motion and bias-field correction, brain extraction, averaging of five scans, and intensity normalisation.

A LEAP-derived T1w midbrain mask was transformed to NM-MRI space [8]. Intensities were trimmed to the 2nd-98th percentiles: upper 20% = SN-like signal; lower 30% = reference.

$$\text{CR (\%)} = 100 \times (S - R) / R$$

S = SN-like median; R = reference median (surrogate metric).

Segmentation-based cross-check & Sensitivity analyses

The SN and CC were delineated using the automated segmentation pipeline. CR was calculated from regional mean signals using the ratio above (S = SN; R = CC), as an anatomical cross-check of the sequence comparison.

The MT-GRE images were smoothed in the through-plane direction to approximate a 3-mm effective resolution to compare with the 3-mm TSE images.

Results

MT-GRE showed consistently higher CR than TSE in all three participants using both the proposed SN-segmentation-free framework and an anatomical SN/CC segmentation-based cross-check.

The higher MT-GRE CR was retained in a sensitivity analysis approximating GRE through-plane resolution

CR approach	MT-GRE (%)	TSE (%)	MT-GRE – TSE
SN-segmentation-free Percentile-based medians	27.49 ± 1.34	15.78 ± 0.33	11.71 pp
SN/CC segmentation Anatomical ROI means	28.15 ± 1.84	16.91 ± 0.57	11.25 pp

percentage point: pp

Conclusions

MT-GRE provided consistently higher CR than TSE across all participants. The proposed SN-segmentation-free framework enables quantitative contrast assessment without precise SN delineation, reducing reliance on segmentation accuracy.

An anatomical SN/CC cross-check reproduced the MT-GRE–TSE contrast difference. Resolution-sensitivity analysis showed that the higher MT-GRE contrast was retained after approximating its through-plane resolution to TSE. These findings also highlight the need for harmonisation across NM-MRI sequences. Further studies in PD and healthy cohorts are needed to assess clinical sensitivity and utility.

Next steps: Repeatability with higher sample size, patient-group discrimination and longitudinal sensitivity remain to be evaluated.

Analysis workflow



Figure 1. Midbrain segmentation is used; explicit SN segmentation is not required. Fixed intensity percentiles provide the surrogate CR measure.

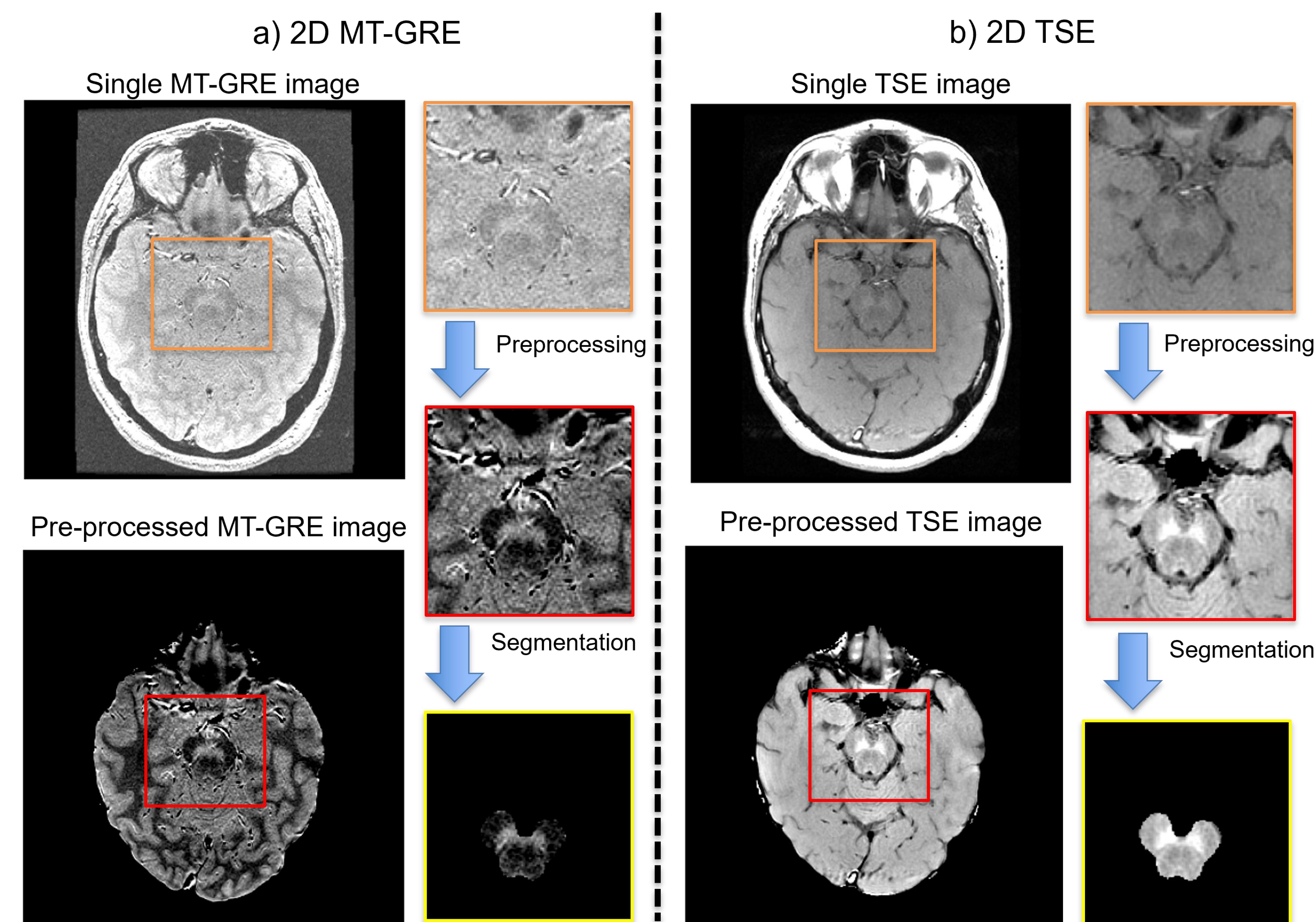


Figure 2. Representative MT-GRE (left) and TSE (right) images. Input panels show one of five scans; processed panels combine all five. Bottom panels are LEAP-derived midbrain-masked images, not SN segmentations.

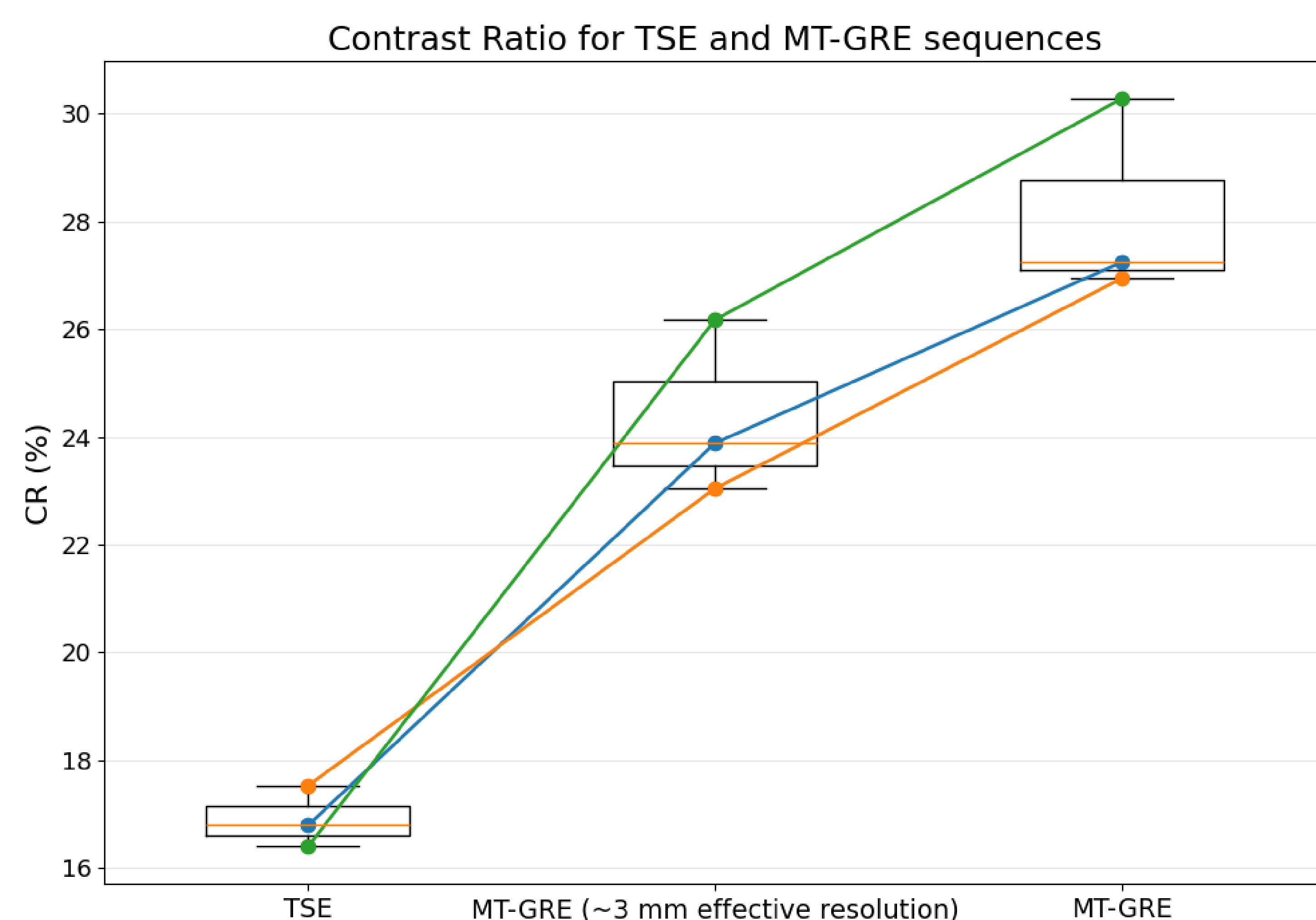


Figure 3. Lines join paired participants. The CR remained higher for the MT-GRE after approximate 3-mm through-plane smoothing.