SCAN-RESCAN AND FIELD-STRENGTH REPRODUCIBILITY OF BRAIN VOLUMETRY AND WHITE MATTER LESIONS DETERMINED USING QYSCORE®, A REGULATORY-APPROVED AUTOMATED SOFTWARE PLATFORM

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BACKGROUND

- **For any biomarker,** an understanding of its intrinsic **measurement variability** is critical in order to ascertain its **sensitivity** to detect biological change.
- In the case of measurements derived from MRI scans, two important sources of variability are **differences in subject positioning within the scanner** and associated calibration adjustments, and the **scanner field strength (1.5T or 3T)** and associated hardware and physics differences.
- **QyScore® is a commercially-available**, automated brain image analysis platform that is CE-marked and FDA-cleared as a medical device.

OBJECTIVES

1. To evaluate the **scan-rescan variability** associated with automated measurements of **brain volumes** at both 1.5T and 3T
2. To evaluate the **scan-rescan variability** in **white matter lesion volume** and count at 3T
3. To evaluate differences in **brain volume** estimates on the **same individuals** scanned at 1.5T and 3T

MATERIALS & METHODS

IMAGING DATA

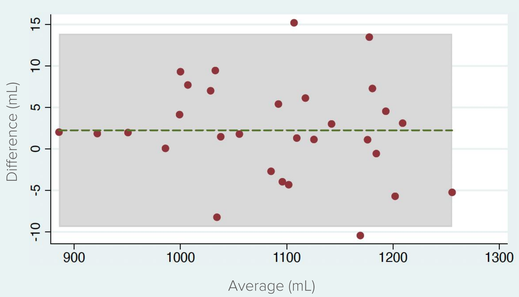
- A total of **30 subjects** (15 HC and 15 MS) were each scanned four times: twice on a 1.5T scanner (GE Signa Excite) and twice on a 3T scanner (Siemens Magnetom Skyra).
- Each of the paired **1.5T and 3T** scans took place on the same day, with the subjects taken out of the scanner in between.
- The 1.5T and 3T scan pairs were acquired between **0 and 47 (mean 2, median 0) days** apart. A 3DT1 sequence was acquired at both field strengths, and a 2D FLAIR sequence at 3T only.
- These scans were analyzed using **QyScore® v1.7.**
- Outcome measures were **whole brain, grey matter, white matter, hippocampus and amygdala volumes** from the 3DT1 scans, and the **count and total volume of white matter lesions** from the FLAIR scans.
- Volumes were corrected by **intracranial volume** (ICV).

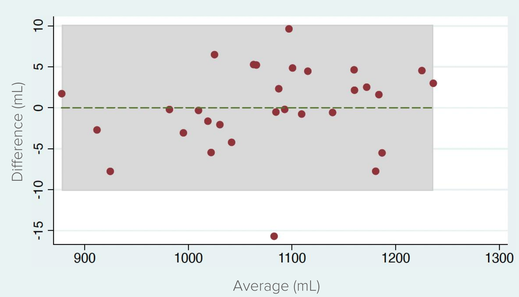
STATISTICS

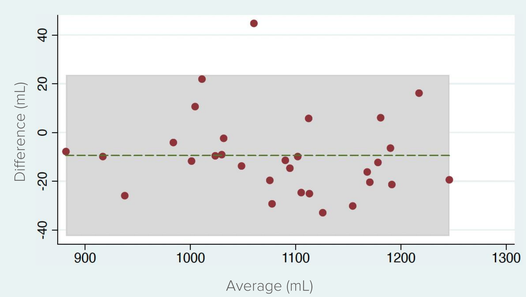
- **Reproducibility** was assessed using intraclass correlation (ICC), as well as Bland-Altman analysis, including bias (mean difference divided by the 95% CI of the difference) and relative variability measures (95% CI divided by the grand average value of the measurand).

RESULTS

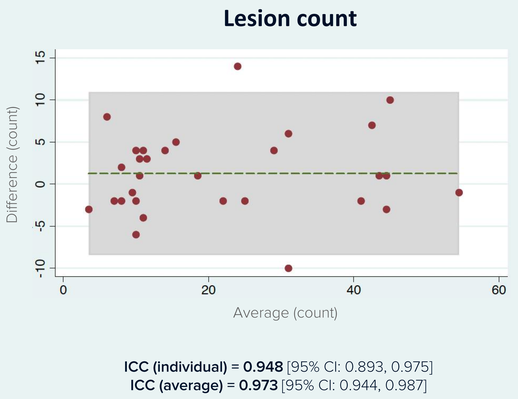
WHOLE BRAIN VOLUME

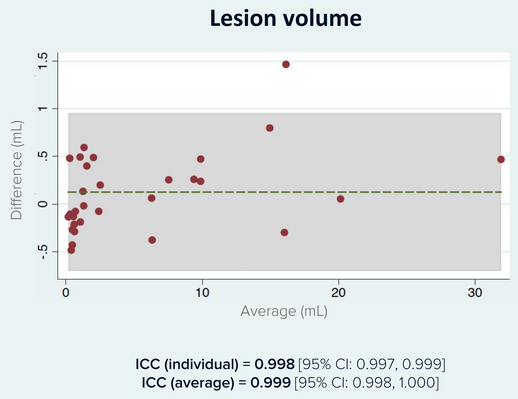






WHITE MATTER LESIONS (SCAN-RESCAN AT 3T)





- For **brain volumes**, the ICC range was 0.784–0.998 (mean **0.945**) at 1.5T and 0.816–0.998 (mean **0.952**) at 3T.
- Bias values were **substantially lower** than the 95% CIs for all regions at both field strengths (-3–7% at 1.5T, -3–21% at 3T), and relative variability ranged from 1–13% at 1.5T and 1–10% at 3T. The most variable region was the amygdala.
- For **white matter lesion volume**, the ICC was **0.998**, bias 15% and relative variability 5%. **Lesion count** ICC was **0.948**, bias 13% and relative variability 33%.
- **Within-subject comparisons between 1.5T and 3T** revealed more variable behavior.
- **Performance for volumes** corrected for ICV was similar, with trends to slightly higher variability.

CONCLUSIONS

- The QyScore® analysis **yielded highly reproducible** within-subject measurements, with the amygdala (smallest region) being most variable.
- This study provides **limits of detectability** for the use of these algorithms to detect change due to disease progression or therapeutic intervention.