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Do we need MRI quality assurance: experience from a multi-unit imaging center with 14 MRI systems

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Purpose

MRI at HUS Medical Imaging Center

- Multi-unit center with 14 MRIs (i.e. three 3T, seven 1.5T, three mobile 1.5T and one dedicated extremity scanner)
- Approx. 63 000 clinical studies/year
- The quality assurance procedures need to be time and resource efficient in a unit with several scanners.
- The purpose of this work is to describe and evaluate our QA protocols.

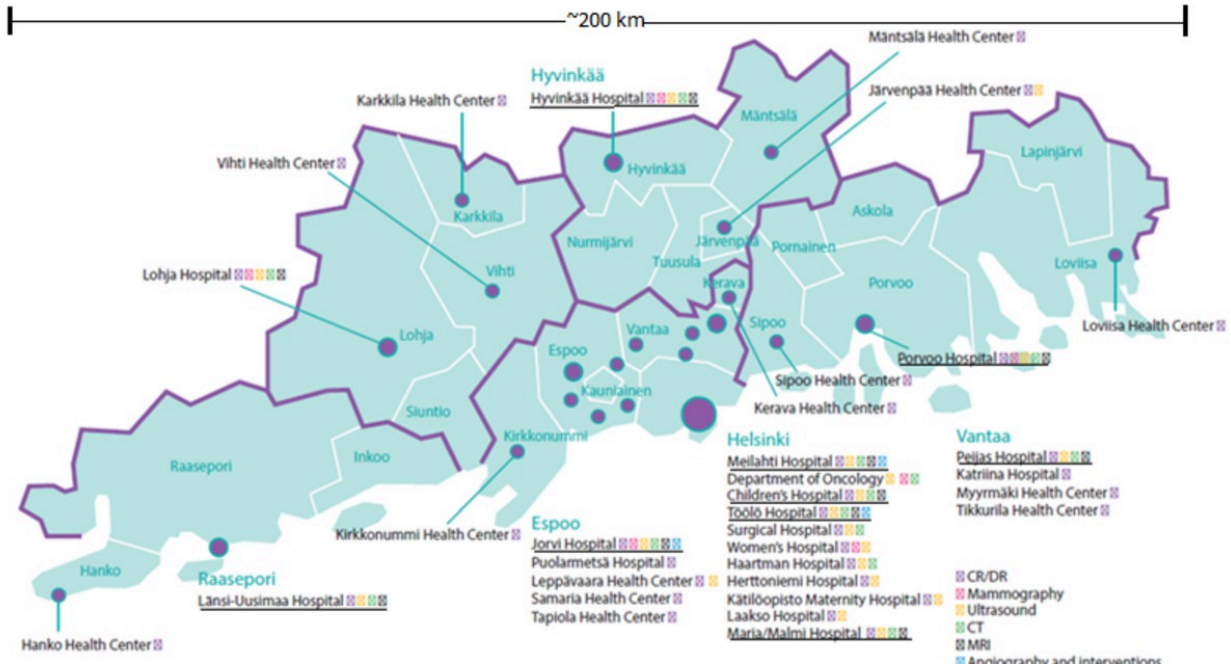

Fig. 1: The MRI units are spread across the southern Finland. The hospital with MRIs are underlined.
References: Radiology, HUS Helsinki Medical Imaging Center - Helsinki/FI

Images for this section:

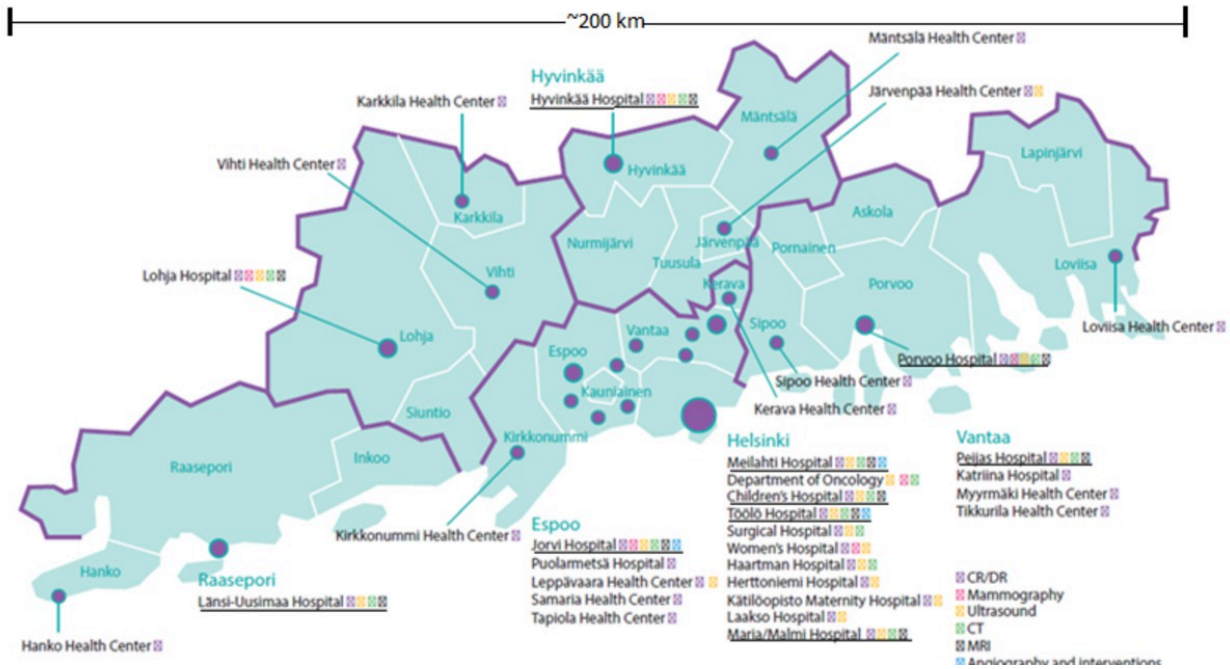

Fig. 1: The MRI units are spread across the southern Finland. The hospital with MRIs are underlined.

Methods and materials

QA consisted of three parts and it was performed on all scanners:

1. Daily test

- A single slice spin-echo image of a homogeneous phantom acquired before clinical studies and sent to a server.
- Automatic analysis of the SNR, ghosting and image intensity uniformity.

2. Annual American College of Radiology (ACR) phantom test

- Performed accoding ACR site scanning instructions, which include acquisition of ACR specific T1 and T2 sequences and also site specific T1 and T2.
- Data was semiautomatically analyzed in line with ACR instructions, which included the assessment of geometric accuracy, spatial resolution, slice thickness, slice position, intensity uniformity and ghosting.

3. Annual manufacturer specific coil tests of approx. 170 coils.

Images for this section:

Fig. 2: One of the scanners at HUS Medical Imaging Center

Results

1. Daily tests

- In daily test, exceptions were observed in 3 scanners.
- One exception was caused by a faulty gradient amplifier

2. ACR phantom test

- In ACR specific T1 and T2 sequence the obtained results did not meet the ACR requirements for three scanners for geometric accuracy.
- For the site specific T1 sequence the the results for ten scanners were not according to spesifications, with inferior results in resolution, geometric accuracy, and slice thickness
- For the site specific T2 sequence seven scanner did not meet the requirements mainly for slice thickness and geometric accuracy.

3. Coil tests

- Five faulty coils were observed with the annual coil tests, that had not been observed otherwise.
- However, we do not have statistics of coils changed for other reasons e.g. image artifact observed in routine imaging.

Conclusion

- MRI personnel think that the daily test are beneficial, because it enables the personnel to test that the scanner is working properly in the morning.

- The automatic analysis of the daily test reduces the time and effort put in to the analysis.
- The automatic analysis of ACR phantom test assures that the image quality is always assessed in the same way.

- Coil tests are quite time and resource consuming, because there are several coils to test per scanner.
- The number of faulty coils in the coil test was quite low (5), because the faults are probably immediately observed as image quality problems.

- We think that QA is necessary and our procedure appears to be sufficient to detect faults and inferior image quality for routine clinical imaging.
- We are also able to manage the quality of a large number of scanners in a resource-efficient way.
- For advanced imaging e.g. fMRI, the current QA-procedures may not be sufficient, because in an EEG-fMRI study the faulty gradient amplifier caused problems before it was observed with the daily tests or ACR test.

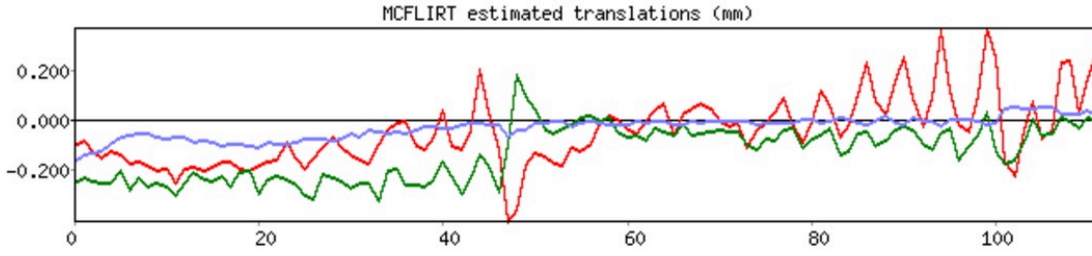

Fig. 3: Output of a motion correction translation parameters from an EEG-fMRI study. After 15 minutes of fMRI acquisition, there was observed severe fluctuation and it persisted for the rest of the imaging session.
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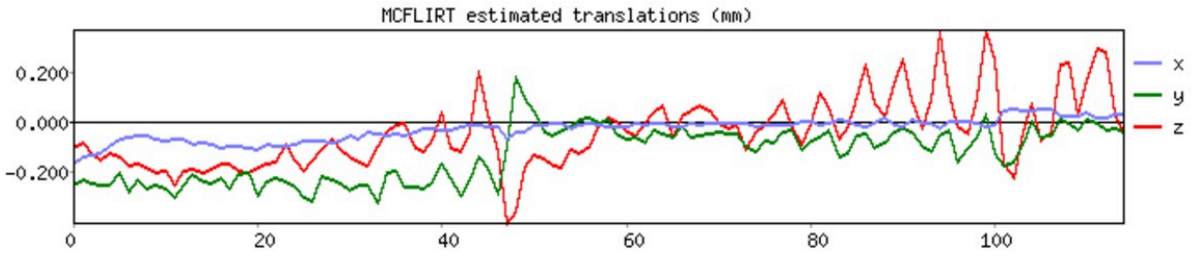

Fig. 3: Output of a motion correction translation parameters from an EEG-fMRI study. After 15 minutes of fMRI acquisition, there was observed severe fluctuation and it persisted for the rest of the imaging session.

References

- Peltonen et al. Automatic Daily MRI Quality Control Analysis System Applied in a Large Hospital District. RSNA proceedings 2014
- Mäkelä et al. Automated analysis of MRI Quality Assurance, The 46th annual meeting of the Finnish Physical Society proceedings. 2012
- Ihalainen et al. MRI quality assurance using the ACR phantom in a multi-unit imaging center. Acta Oncologica 2011
- The American College of Radiology: Site Scanning Instructions for Use of the MR Phantom for the ACR™ MRI Accreditation Program 2012