

# Do we still need contrast agent to maximize sensitivity for new lesions in Multiple Sclerosis?

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## Purpose

Contrast agent is considered to be mandatory in MRI follow up scans of patients with Multiple Sclerosis (MS). However, as patients with MS receive a multitude of MR scans over lifetime, they are especially prone to developing intracranial gadolinium depositions. Hence, a more differentiated use of contrast agent seems inevitable for future MR protocols in MS patients.

One of the main justifications for contrast agent in MS follow up scans is to maximize sensitivity for new lesions. This is based on a result from 1993<sup>1</sup>. We investigated, whether this still holds true when a modern imaging protocol together with computational post processing techniques are used.

## Methods

### Subjects:

507 follow up MR scans from 359 patients with MS or Clinically isolated syndrome.

### MR Protocol:

- 3D FLAIR
- 3D T1 +/- Gadolinium
- 3D T2
- 3D Double inversion recovery (DIR)

### Field strength:

3 Tesla (Philips Achieva)

### Additional postprocessing:

- Co-Registration of all images from a single patient
- Generation of a longitudinal subtraction map of the DIR sequences<sup>2</sup>
- Optimized subtraction maps of T1 sequences with and without contrast agent

### Data analysis:

Two independent readouts:

1. Identification of new lesions in non-enhanced images
2. Identification of contrast enhancing lesions

In each readout, the identified lesions were marked. These markings were finally compared and discrepant lesions were counted, i.e. those lesions which showed a contrast enhancement but were not detected as new lesions in readout 1.

## Results

Identified new lesions: **1992** in 264/507 scans  
Contrast enhancing lesions: **207** in 69/507 scans  
Discrepant lesions: **4** in 3/507 scans

Retrospectively, every discrepant lesion was identified as a new lesion that was missed during the first readout. An example is shown in the figure below. There was no contrast enhancement in a preexisting and unchanged lesion.

The findings above translate into a number needed to be given contrast agent of 169 to identify one scan with new lesions that were not detected without contrast agent.

Moreover, the 3 scans in which the discrepant lesions were found all showed a high burden of (correctly identified) new lesions (minimum: 27).

## Discussion

In our study, only 0.2% of all new lesions were missed without the use of contrast agent. Moreover, the lesions which were additionally detected did not contribute to the assessment of overall lesion load in a single case. Also, there was not a single preexisting and unchanged lesion that showed a contrast enhancement.

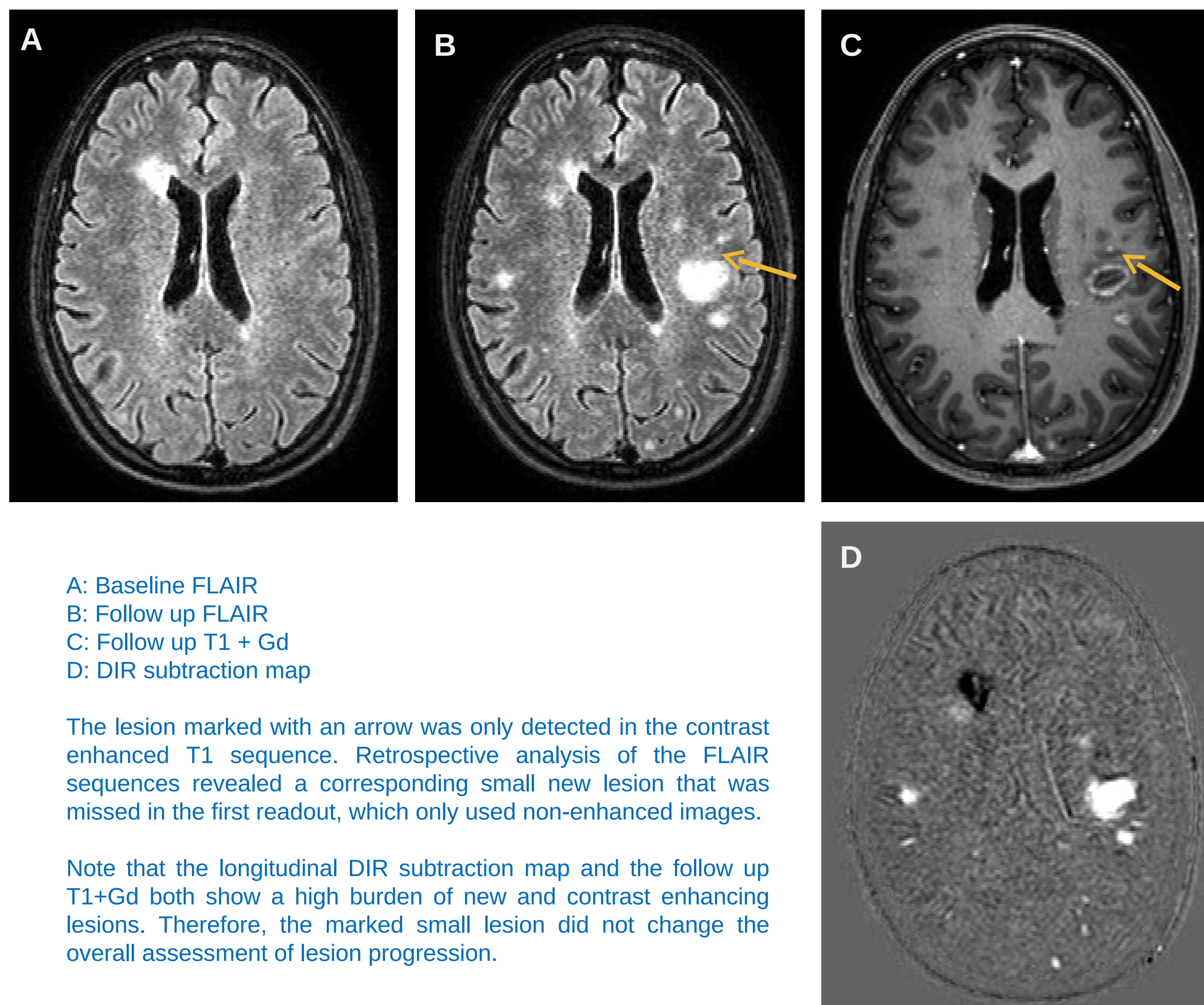
This allows for the following conclusions:

1. Contrast agent can be regarded as dispensable for the detection of new lesions.
2. In scans which do not show new lesions, contrast agent does not provide additional information on disease activity

Based on our observations, the only remaining use of contrast agent is the additional information on lesion age. We therefore propose to limit the administration of contrast agent to situations, in which this temporal information has direct consequences for therapy.

This proposed strategy can help to substantially reduce the cumulative lifetime dose of contrast agent in MS patients and therefore the risk of intracranial gadolinium depositions.

## Figure: Example of a lesion missed without contrast agent



## References:

1. Miller DH, Barkhof F, Nauta JJ. Gadolinium enhancement increases the sensitivity of MRI in detecting disease activity in multiple sclerosis. *Brain* 1993;116(5):1077-1094
2. Eichinger P, Wiestler H, Zhang H, et al. A novel imaging technique for better detecting new lesions in multiple sclerosis. *J Neurol* 2017;264(9):1909-1918