

A few years ago only few centres had ultra high field MRI facilities and only some of them had associated clinical teams interested in Multiple Sclerosis. The necessary optimisation of imaging took some time but the last few years a number of significant publications have appeared that demonstrate the ability and value of using ultra high field imaging in MS.

Ultra high field in MS so far has been shown to improve detection of Grey matter lesions. Grey matter pathology appears to be different than the pathology affecting the white matter. We still do not understand those difference and UHF MRI promises to assist detecting accurately the extent and nature of GM abnormalities. So far 7T studies have shown a higher number of focal GM lesions compared to DIR at lower field. Importantly, by combining lower and ultra high field imaging it has been demonstrated that some apparent GM lesions on DIR might be sub cortical abnormalities or due to artefact. Furthermore, with lower resolution it is impossible to categorise the exact subtype of GM lesions whereas a number of 7T studies have shown that this is possible. The use of MTR also at 7T give promising results in understanding the myelination changes in the GM. Pathology reports suggest that GM remyelination might be more extensive compared to the WM. This needs to be confirmed in vivo as remyelination studies are currently underway testing new treatment compounds. It is anticipated that more remyelination compounds will reach the clinical study stage soon.

The white matter pathology although studied for years can be reviewed more thoroughly by UHF imaging. Studies have shown more white matter lesions that were invisible by 3T FLAIR suggesting that some of the normal appearing white matter abnormalities reported previously might be due to small WM lesions previously undetected.

In addition to more lesions we can now visualise the microstructure of white matter lesions more accurately. T2* imaging have shown clearly the perivenular location of WM lesions. This has been confirmed to be a feature of most lesions in all disease subtypes, irrespective of the duration of the disease. This diagnostically promising feature (which is not present in many other white matter lesions) has now been translated and can be appreciated at 3T also demonstrating the principle of applying UHF MRI finding in many MS centres with lower field scanners.

The presence of iron inside and around the lesions has attracted also attention with a number of MRI pathology correlation studies and numerous attempts to quantify the iron as a marker of CNS degeneration. Some of the studies will be reviewed but the need for more quantitative investigations will be made. In addition the promising use of MRS at 7T and the potential benefits of high field for atrophy measurements will be presented.