Fat suppression

Fat suppression is commonly used in magnetic resonance (MR) imaging to suppress the signal from adipose tissue or detect adipose tissue.

It can be applied to both T1 and T2 weighted sequences.

Due to short relaxation times, fat has a high signal on magnetic resonance images (MRI). This high signal, easily recognised on MRI, may be useful to characterise a lesion.

However, small amounts of lipids are more difficult to detect on conventional MRI. In addition, the high signal due to fat may be responsible for artifacts such as ghosting and chemical shift. The high signal can also mask subtle contrast difference in non-fatty tissue by filling the dynamic range of the receiver with mostly fat signal. Lastly, a contrast enhancing tumour may be hidden by the surrounding fat. These problems have prompted development of fat suppression techniques in MRI.

Fat suppression can be achieved in a number of different ways:

difference in resonance frequency with water by means of frequency selective pulses (CHESS)

phase contrast techniques (by same mechanism as black boundary or india ink artifacts)

short T1 relaxation time by means of inversion recovery sequences (STIR technique)

Dixon method

hybrid techniques combining several of these fat suppression techniques such as SPIR (spectral presaturation with inversion recovery)

Selection of a fat suppression technique should depend on the purpose of the fat suppression (contrast enhancement vs. tissue characterisation) and the amount of fat in the tissue being studied, the field strength of the magnet and the homogeneity of the main magnetic field.

Sagittal T1w, T2w, and fat-suppressed fluid-sensitive MRI images of 100 consecutive patients (consequently 500 vertebral segments; 52 female, mean age 74 ± 7.4 years; 48 male, mean age 71 ± 6.3 years) were retrospectively evaluated.

Finkenstaedt et al., recorded the presence (yes/no) and extension (i.e., Likert-scale of height, volume, and end-plate extension) of Modic I changes in T1w/T2w sequences and compared the results to fat-suppressed fluid-sensitive sequences (McNemar/Wilcoxon-signed-rank test). Results Fat-suppressed fluid-sensitive sequences revealed significantly more Modic I changes compared to T1w/T2w sequences (156 vs. 93 segments, respectively; $p < 0.001$). The extension of Modic I changes in fat-suppressed fluid-sensitive sequences was significantly larger compared to T1w/T2w sequences (height: 2.53 ± 0.82 vs. 2.27 ± 0.79, volume: 2.35 ± 0.76 vs. 2.1 ± 0.65, end-plate: 2.46 ± 0.76 vs. 2.19 ± 0.81), ($p < 0.05$). Modic I changes that were only visible in fat-suppressed fluid-sensitive sequences but not in T1w/T2w sequences were significantly smaller compared to Modic I changes that were also visible in T1w/T2w sequences ($p < 0.05$).

In conclusion, fat-suppressed fluid-sensitive MRI sequences revealed significantly more Modic I end-plate changes and demonstrated a greater extent compared to standard T1w/T2w imaging.

When the Modic changes classification was defined in 1988, T2w sequences were heavily T2-weighted and thus virtually fat-suppressed.. · Nowadays, the bright fat signal in T2w images masks edema-like changes.. · The conventional definition of Modic I changes is not fully applicable anymore.. · Fat-suppressed fluid-sensitive MRI sequences revealed more/greater extent of Modic I changes [1].

[1]
Finkenstaedt T, Del Grande F, Bolog N, Ulrich N, Tok S, Kolokythas O, Steurer J, Andreisek G, Winklhofer S; LSOS Study Group. Modic Type 1 Changes: Detection Performance of Fat-Suppressed Fluid-Sensitive MRI Sequences. Rofo. 2017 Nov 27. doi: 10.1055/s-0043-118130. [Epub ahead of print] PubMed PMID: 29179238.