

Maintaining image quality while reducing acoustic noise and switched gradient field exposure during lumbar magnetic resonance imaging

Anton Glans^{1,2}, Jonna Wilén², Lenita Lindgren¹

¹ Umeå Universitet, Institutionen för omvårdnad

² Umeå Universitet, Institutionen för strålningsvetenskaper

Introduction and aim

Acoustic noise during magnetic resonance imaging (MRI) can contribute to patient discomfort and potentially be harmful. One way to reduce this noise is by altering the gradient output and/or waveform using software optimization. Such modifications might influence image quality and switched gradient field exposure, and different techniques appear to affect sound pressure levels to various degrees. Our aim was to evaluate sound pressure levels, image quality, switched gradient field exposure, and participants' perceived noise levels during two different acoustic noise reduction techniques, Quiet Suite (QS) and Whisper Mode (WM), and to compare them with conventional T2-weighted turbo spin echo (T2W TSE) of the lumbar spine.

Materials and methods

Using a prospective within-subjects design, we included 40 adults that were referred for lumbar MRI. Participants were scanned with all three sequences, i.e. conventional T2W TSE, T2W TSE with QS, and T2W TSE with WM, in a randomized order at a 1.5T system. We compared the sequences' peak sound pressure levels (A-weighted decibels, dBA) and participants rated how they perceived the noise levels on a Borg CR10®-scale. For image quality evaluation, we compared signal-to-noise ratio (SNR), contrast-to-noise ratio (CNR) and three radiologists' qualitative assessments in image quality on an ordinal scale 1–4. Interobserver reliability was reported as percentage agreement. We used repeated measures ANOVA, Friedman's ANOVA and Wilcoxon's Signed-Rank test for statistical testing. Lastly, switched gradient field exposure (% general public) and gradient currents were measured.

Results

Mean peak sound pressure levels were 89.9 dBA, 74.3 dBA, and 78.8 dBA for conventional, QS, and WM, respectively ($P < 0.05$). This translates to an 84% sound pressure reduction using QS, and 72% reduction using WM, compared to conventional. Participants perceived QS as the quietest and conventional as the loudest sequence ($P < 0.05$). No qualitative differences in image quality were seen ($P > 0.05$), although QS showed significantly improved SNR and CNR compared to the conventional sequence ($P < 0.05$). Switched gradient field exposure was reduced by 66% and 48% for QS and WM, respectively.

Conclusion

Without degrading image quality, both QS and WM are viable acoustic noise reduction techniques in lumbar T2W TSE. QS provided the lowest sound pressure level, the lowest gradient field exposure and was perceived as the most silent among the three sequences.