A142 Influence of a 1.5 Tesla (1.5T) Magnetic Resonance Imaging (MRI) on Ferromagnetic Microtraces

Rianne Groot, Jacob Boekestraat 175, Nieuw Vennep, Noord Holland 2152AH, NETHERLANDS; Paul Hofman, PhD, Maastricht University Medical Center, Dept of Radiology, Maastricht 6202 AZ, NETHERLANDS; Reza R.R. Gerretsen, MD, Netherlands Forensic Institute, Laan Van Ypenburg 6, The Hague 2497 GB, NETHERLANDS; Mayonne Van Wijk, MSc, Netherlands Forensic Institute, Laan Van Ypenburg 6, The Hague 2497 GB, NETHERLANDS; Jeroen Kroll, Maastricht University Medical Center, P Deyelaan 25, Maastricht 6229HX, NETHERLANDS; Erwin Vermeij, Netherlands Forensic Institute, Laan Van Ypenburg 6, The Hague 2497GB, NETHERLANDS; and Steven B.C.G. Chang, MSc, Netherlands Forensic Institute, Laan van Ypenburg 6, The Hague 2497GB, NETHERLANDS*

The goal of this presentation is to determine the influence of the external magnetic field of a 1.5T MRI scanner on the location of ferromagnetic microtraces smaller than 0.5mm in and on bone and in soft tissue.

This presentation will impact the forensic science community by explaining how Postmortem Magnetic Resonance Imaging (PMMR) is increasingly used in forensic medical examinations of crime victims.[1] The findings of this study have important implications for the application of PMMR. During autopsy, perforating injuries are measured and the depth of stab wounds are probed. Injuries extending into the bone are excised and examined for the presence of foreign materials. These microtraces are used to reconstruct a crime event, and microtraces may be linked to a specific (class of) object or weapon.[2] The presence of the external magnetic field in PMMR may disturb evidence when human remains contain ferromagnetic microtraces. Knives consisting of steel or contaminated with steel are known to leave ferromagnetic microtraces smaller than 0.5mm in soft tissue, on bone, or even embedded in bone.[2] Translocation may lead to mistakes in reconstructing a crime event. After attending this presentation, attendees will understand the influence the external magnetic field of a 1.5T MRI can have on microtraces.

Hypothesis: Translocation of microtraces smaller than 0.5mm was not expected. Calculations made before the experiments indicated that the magnitude of forces due to friction and gravity would be greater than the magnetic force on the microtraces.

Methods: Pig feet were used to simulate human remains. The samples were cut with a saw that was contaminated with ferromagnetic steel. The samples contained ferromagnetic particles from 0.2mm to 0.7mm. Computed Tomography (CT) and micro-CT were used to determine the coordinates of the position of the ferromagnetic microtraces before and after exposing the specimens to a 1.5T MRI scanner. Paired *t*-tests were used to statistically assess the translocation. Translocation due to the external magnetic field of MRI and translocation due to transportation were determined separately to preclude the possibility that translocation was caused by transportation instead of the external magnetic field of MRI.

Results: No significant translocation of the ferromagnetic microtraces (with a size of 0.2mm to 0.7mm) due to the external magnetic field of a 1.5T MRI scanner was detected (*p*-values: X 0.31, Y 0.11, Z 0.11). Transport of the pig feet between institutions caused a significant movement in one dimension (X-axis) that was detected (*p*-values: X 0.03, Y 0.41, Z 0.88); however, this movement was not relevant for forensic examination.

Conclusion: The use of 1.5T MRI in forensic medical examinations is applicable in the presence of small ferromagnetic fragments no larger than 0.7mm.

Reference(s):

1. Baglivo M., Winklhofer S., Hatch G.M., Ampanozi G., Thali M.J., Ruder T.D. The rise of forensic and post-mortem radiology — Analysis of the literature between the year 2000 and 2011. *J Forensic Radiol Imaging*. Elsevier; 2013;1(1):3–9. Available from: https://doi.org/10.1016/j.jofri.2012.10.003.
2. Vermeij E.J., Zoon P.D., Chang S.B.C.G., Keereweer I., Pieterman R., Gerretsen R.R.R. Analysis of microtraces in invasive traumas using SEM/EDS. *Forensic Sci Int.* (Internet.) Elsevier Ireland Ltd; 2012; 214(1–3): 96–104. Available from: http://dx.doi.org/10.1016/j.forsciint.2011.07.025.

Magnetic Resonance Imaging, Microtraces, Translocation

*Presenting Author