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Editorial

The Safety of High-Field MRI?

S Yilmaz

Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Kirikkale University, Kirikkale, Turkey

The last two decades have witnessed dramatic development in medical and dental imaging, which gave practitioners clinical facility and comfort to patients. MRI is often considered as a fast and noninvasive diagnostic modality that can be used on entire human body, especially for the central nervous system, musculoskeletal system, head and neck, abdomen and pelvic examinations. MRI is useful in examination of craniomaxillofacial area.[1,2] Unlike the routine x-ray-dependent techniques, MRI requires special equipment such as a separate room, which isolates the area from radiowaves with Faraday cage, strong magnetic fields (static and variable) generated by superconductors, and radio frequency equipment (transmitter, receiver coils and amplifier).

High-field MR devices are superior to conventional MR machines for their ability to generate images with the same spatial resolution two-times faster, and in the same time frame with two-times more signal provision.[3,4] The effects of strong magnetic field of the device are among the major disadvantages of MRI. The magnetic field is strong enough to pick heavy objects up and pull them towards the scanner at very high speed, a phenomenon the so-called "projectile effect." The accidents are commonly originated from metallic objects, implants and biomedical devices, which become nonfunctional with the effect of magnetic field and generate life-threatening situations such as dislocations and warming.[4,5]

Many objects become magnetized when placed in an external magnetic field. The degree of magnetism depends primarily on the composition of the material. Many metallic objects are frequently located in orofacial region. Precious and nonprecious metal alloys, amalgam, pure gold fillings, titanium and titanium alloys are ingredients of dental crowns, onlay and inlay restorations, fixed bridges, orthodontic brackets and arches, fixed splints, implants, reconstruction materials (*eg*. miniplates and miniscrews, and stainless steel wires).[5] To characterize the properties of these materials, *in vitro* test methods are designed for patient safety. Dental materials are generally considered "safe for MRI" because of their minimal deflection in the static magnetic field. Recent studies, however, revealed uncertain results on mercury release from amalgam after MRI and have questioned the safety of the procedure.

One of the most popular conflicting subjects is mercury release from amalgam filling materials. The "21st century amalgam war" focused on mercury release due to exposure to electromagnetic waves, such as use of cell phones, x-ray machines and MRI. Some investigations support the idea of harmful effects of the mercury release occurred in these situations; others could not find any strong correlations. In the current issue of the journal, we read an article on the effect of magnetic flux on dental amalgam fillings.[6] It shows that exposure to MRI after 24 hours of dental

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Correspondence to Selmi Yilmaz (Yardimci), Department of Oral and Maxillofacial Radiology, Faculty of Dentistry, Kirikkale University, Kurtuluş Mahallesi 692. Sokak No: 31. Merkez, Kirikkale, Turkey
Tel: +90-318-224-4927
Fax: +90-318-225-0685
E-mail: selmiyard@gmail.com
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filling would cause elevation of urinary mercury level even after 72 hours of exposure. The study has several limitations including the low sample size, however, it raises an important issue about the safety of MRI, considering the ubiquitous use of amalgam worldwide and the potential of mercury toxicity.

Dental amalgam consists of silver, tin, copper, palladium, indium, zinc and mercury. These materials have different magnetic characteristics. A major part of amalgam is mercury. Mercury melts at −39 °C. Therefore, at room temperature mercury gives off vapor to the environment. Removal of dental amalgam is associated with the maximal mercury vapor release. The mercury level in plasma and urine demonstrates a small peak that recovers after a short period.

Mercury is slightly diamagnetic; *ie*, atoms of mercury have no unpaired electrons and thus, are not attracted to static magnetic fields. The release of mercury from amalgam by MRI is therefore, thought to occur due the radio waves, which can induce vaporization, not the static magnetic field.

The clinical use of high-field MRI systems is extensive worldwide. High-field MRI uses a stronger static magnetic field, faster and stronger gradient magnetic fields, and more powerful radio frequency. This situation needs reconsideration of the safety of metallic objects. In scientific literature, there is not enough data on long-term outcome and safety issues of being examined with MRI. Therefore, high-field and ultra-high-filed MRI, may not be considered as a "completely safe procedure" unless more scientific papers examine all the safety issues.

Conflicts of Interest: None declared.

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