

Recent Developments in Tattoo Removal Methods and Potential Implications for MRI Patient Safety

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Target Audience: Those responsible for the safe MR scanning of patients including anyone involved in developing patient screening procedures.

Purpose: While laser based tattoo removal techniques aid natural body mechanisms to reduce conspicuity, conductive ink constituents remain and migrate to other regions deeper within the body. Thus the MRI safety profile of tattoos may remain unchanged or even more complex. With the increasing number of tattoos and tattoo removals, caution is needed to identify all existing or partially removed tattoos, either decorative or cosmetic, during the patient screening process.

Methods: Laser tattoo removal methods are most common, in addition to dermabrasion (mechanical abrasion of skin), cryosurgery (liquid nitrogen application causes skin to peel off), excision etc. The laser is tuned for maximal absorption by the ink to break chemical bonds in the pigment and create shock waves that fracture ink droplets in a process called photothermolysis and is more effective with dark inks. Natural body mechanisms then remove some fraction of the tattoo from the primary site into the lymphatic system or liver.

Results: Ink density in tattoos is estimated at 2.5 mg/cm²[1]. Infrequently, burns or swelling is reported as a result of either decorative or cosmetic tattoos [2]. CT images [3] of tattoos removed by laser show metal particles remain at the primary site and in nearby lymph nodes.

Discussion: It is not known what fraction of a tattoo needs to be removed to reduce or eliminate the MRI risk at the primary site. It is also unknown whether the distribution of ink metal elsewhere in body introduces a new risk for MRI. A poll [4] suggests that tattoo prevalence in younger age cohorts that infrequently require an MRI is approximately 4X larger than the older age cohorts where MRI utilization is 3X higher than younger age cohorts. It is estimated [5] that ~10% of people with tattoos have them removed. We can anticipate more patients presenting for MRI both with tattoos, and partially removed tattoos. Many screening forms ask if tattoos are present, but do not inquire about previously removed tattoos. Many screening forms also specifically ask about permanent cosmetics in case some patients do not appreciate these are tattoos, but do not inquire about previously removed permanent cosmetic treatments.

Conclusion: While laser methods may reduce tattoo conspicuity, the MRI risk profile may remain unchanged because conductive ink components may remain. The risk profile may even get worse as the conductive ink components enter the lymphatic system, concentrate in lymph nodes and create new conductive paths. Therefore while we consider current recommendations [6] to be appropriate, we recommend that patient questionnaires be amended to inquire about any tattoo history, including that of tattoo removal, and to additionally ask about “permanent cosmetics” or their removal, to ensure that all tattoo history is assessed.

References: [1] Engel E, Vasold R, Santarelli F, et al. Tattooing of skin results in transportation and light-induced decomposition of tattoo pigments--a first quantification in vivo using a mouse model. *Exp Dermatol*. 2010 Jan 2010; 19(1):54-60. [2] Franiel T, Schmidt S, Klingebiel R. First-degree burns on MRI due to nonferrous tattoos. *AJR Am J Roentgenol*. 2006 Nov 2006; 187(5). [3] Kobayashi H, Togashi K. CT of tattoos removed with laser therapy. *AJR Am J Roentgenol*. 2000 May 2000; 174(5):1468-1469. [4] 2008 Harris Poll. <http://www.harrisinteractive.com/vault/Harris-Interactive-Poll-Research-Three-in-Ten-Americans-with-a-Tattoo-Say-Having-One-Makes-Them-Feel-Sexier-2008-02.pdf>. [5] Vasold R, Naarmann N, Ulrich H, et al. Tattoo pigments are cleaved by laser light-the chemical analysis in vitro provide evidence for hazardous compounds. *Photochem Photobiol*. 2004 Sep-Oct 2004; 80(2):185-190. [6] Kanal E, Barkovich AJ, Bell C, et al. ACR guidance document for safe MR practices: 2007. *AJR Am J Roentgenol*. 2007 Jun 2007; 188(6):1447-1474.