

# Magnetic Resonance Imaging and cochlear implants



**Magnetic Resonance Imaging (MRI) examination plays a vital and increasing role in medical diagnostics. Only Cochlear™ Nucleus® Cochlear Implants allow MRI examination with or without the magnet in place<sup>1</sup> and are compatible with 3.0 Tesla MRI with the magnet removed (Risi, et al., 2004). This information supports CI professionals counselling their patients.**

## THE INCREASING RELEVANCE OF MRI DIAGNOSTICS

The use of MRI in both clinical practice and emergency medicine is increasing rapidly. MRI has revolutionised the evaluation of congenital anomalies such as those that impact the nervous system or cardio-pulmonary system, (Dhamankar, et al., 2005) this evaluation and subsequent treatment is of particular importance for paediatric patients. MRI is also an important tool in the diagnosis of many diseases which are particularly prevalent in an aging

society; such as Alzheimer's disease (Marilyn Albert, et al.), coronary disease (Blumenke, et al., 2008), acute stroke (Chalela, et al., 2007) or skeletal issues. MRI enables early detection and management of these medical conditions, ultimately leading to increased cost effectiveness (Clark, 2010) and improved quality of life. Unlike most other imaging techniques, MRI does not use potentially harmful ionising radiation and has not been associated with increased risk of cancer (Clark, 2010). MRI is without doubt the most versatile of all medical diagnostic technologies (Blamire, 2008). Future innovation in the field of MRI generally involves higher magnetic field strength (Macovski, 2009). In the next 10 years it is expected that in clinical practice there will be a widespread shift from 1.5 to higher 3.0 Tesla imaging (Blamire, 2008) (Majdani, et al., 2008). Increasing the MRI field strength improves the relationship between field strength and the signal-to-noise ratio (SNR). By increasing the signal there is an improvement in either the image detail or the speed of image acquisition, or both

(Dagia & Ditchfield, 2008). The increased field strength, due to stronger magnets, is particularly beneficial for neuroimaging (Bronson, 2006).

## DIFFERENT COCHLEAR IMPLANTS INTERACT DIFFERENTLY WITH MRI

Cochlear implants differ in how they interact with the MRI magnetic fields. (Majdani, et al., 2008). This has implications on CI counselling.

MRI procedures result in interactions with ferromagnetic components of the implant, especially the implant magnet. This can result in potentially harmful forces being generated or partial or complete demagnetisation of the implant magnet. The implanted magnets also create significant image artifacts in head scans and this can diminish the diagnostic value of the procedure; particularly in users with bilateral cochlear implants.

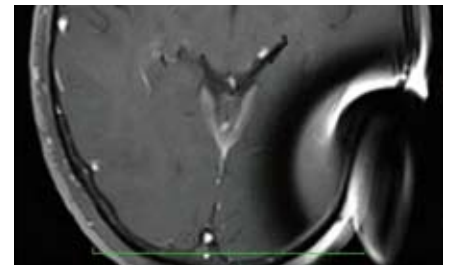


Image 1: magnet removed  
Image courtesy Dr Robert Briggs



Image 2: magnet in place  
Image courtesy Department of Neuroradiology, Medizinische Hochschule Hannover, Germany

The ability to remove and replace the magnet without the need for CI explanation and subsequent re-implantation is possible only with the Cochlear Nucleus Implant<sup>1</sup>. This is important, whether for compulsory removal due to excessive forces and demagnetisation at 3.0 Tesla (Majdani, et al., 2008), the desire for clearer head scans at 1.5 Tesla (Risi, et al., 2004), or for instances of demagnetisation as a result of repeated MRI procedures (Majdani, et al., 2008).

Active medical devices such as Cochlear Implants also interact with the RF field of MRI machines, which may lead to additional device related issues such as unintended stimulation, degradation of implant function or heating (Risi, et al., 2004). Therefore it is important that CI users only undergo MRI procedures for which their implant type has been tested and has regulatory approval.

## COCHLEAR IMPLANTATION SHOULD NOT UNDULY RESTRICT MRI ACCESS

Future medical diagnostics is an important consideration in CI candidate counselling. Optimal access to MRI examination is likely to become even more important in the future; thus it should not be unduly restricted. Children are very likely to undergo multiple MRI procedures during the course of their life while, for adult patients, MRI diagnostics will be important in the management of degenerative diseases that are prevalent in an aging society.

## ONLY NUCLEUS COCHLEAR IMPLANTS HAVE A REMOVABLE MAGNET AND APPROVAL FOR 3.0 TESLA MRI WITH MAGNET REMOVED

Only Cochlear Nucleus implants offer the choice to undergo MRI up to 1.5 Tesla with or without prior removal of the magnet; and only Nucleus Cochlear implants are approved for 3.0 Tesla procedures with the magnet removed.

## REFERENCES

- Bluemke DA, Achenbach S, Budoff M, Gerber TC, Gersh B, Hillis LD, et al. (2008). Noninvasive Coronary Artery Imaging: Magnetic Resonance Angiography and Multidetector Computed Tomography Angiography: A Scientific Statement From the American Heart Association Committee on Cardiovascular Imaging and Intervention of the Council on Cardio. *Journal of the American Heart Association*, 586-606.
- Bronson JG (2006, August). 3T: Ready for Prime Time? Retrieved March 28, 2011, from *Imaging Economics*: [http://www.imagingeconomics.com/issues/articles/mi\\_2006-08\\_01.asp?mode=print](http://www.imagingeconomics.com/issues/articles/mi_2006-08_01.asp?mode=print)
- Chalela JA, Kidwell CS, Nentwich LM, Lugby M, Butman JA, Demchuck AM, et al. (2007). Magnetic resonance imaging and computed tomography in emergency assessment of patients with suspected acute stroke: a prospective comparison. *Lancet*, 293-298.
- Clark C (2010, July 28). Doctors need decision support in ordering imaging diagnostics. Retrieved April 4, 2011, from *Health Leaders Media*: <http://www.healthleadersmedia.com/print/COM-254401/Doctors-Need-Decision-Supp>
- Dagia C, Ditchfield M (2008). 3T MRI in Pediatrics: Challenges and Clinical Applications. *European Journal of Radiology* 68, 309-319.
- Dhamankar MM, Meyer HP, Wohlfarth KR (2005). MRI Hot Topics: Pediatric Imaging at 3T. *Malvern: Siemens Medical Solutions*.
- Harmon K (2010, October 5). A Surge in CT and MRI Scans Has Not Boosted Diagnosis Rates. Retrieved April 4, 2011, from *Scientific American*: <http://www.scientificamerican.com/article.cfm?id=ct-mri-diagnosis-rate>
- Macovski AP (2009). MRI: A Charmed Past and an Exciting Future. *Journal of Magnetic Resonance Imaging* 30, 919-923.
- Majdani O, Martin L, Rau T, Akbarian A, Zimmerling M, Lenarz M, et al. (2008). Demagnetization of cochlear implants and temperature changes in 3.0T MRI environments. *Otolaryngology – Head and Neck Surgery*, 833-839.
- Albert M, DeCarli C, DeKosky S, de Leon M, Foster NL, Fox N, et al. the use of MRI and PET for Clinical Diagnosis of Dementia and Investigation of Cognitive Impairment: A consensus report. *Alzheimer's Association Neuroimaging Work Group Consensus Report*.
- Risi F, Saldanha A, Leigh R, Gibson P. (2004). Magnetic resonance imaging safety of Nucleus 24 cochlear implants at 3.0 T. *International Congress Series* 1273 (pp. 394-398). Elsevier.

<sup>1</sup> The magnet can stay in place for MRI up to 1.5 T and needs to be temporarily removed for procedures with higher field strength. Bandaging might be required. See MRI for Nucleus Implant recipients Radiographer's instructions, N31559f ISS2

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