Magnetic Properties of Medtronic ENT Otology Implant Devices

July 2009

RE: Magnetic Properties of Medtronic ENT Otology Implant Devices

To whom it may concern:

The effects of Magnetic Resonance Imaging (MRI) scans on Medtronic ENT otology implants are addressed below. Included in the scope of this letter are all otology implants, including both ossicular (middle ear) prostheses and ventilation tubes that are composed of one or more of the following available materials:

**Stainless steel (Austenitic grade, ASTM F138)**

**Titanium or titanium alloy (ASTM F67 and F136)**

**Platinum**

**Porous polyethylene polymer or polyethylene with stainless steel wire**

**Fluoroplastic polymer or fluoroplastic with stainless steel wire**

**Hydroxylapatite and hydroxylapatite composite with silicone elastomer**

Generally, MRI scans are contraindicated for patients with certain metallic and metal-containing devices, such as selected aneurysm clips, select cochlear implants (i.e., Medtronic ENT Audiant, etc.), or neurostimulator TENS units. However, studies conducted on otology devices manufactured from the above materials, by Medtronic ENT as well as other otology device manufacturers, support the lack of significant hazard for patients with middle ear implants undergoing MRI scans.

In an attempt to provide guidance to the user on material MR compatibility, the following criteria are used to determine the level of material/MR compatibility.

- Magnetically induced displacement force and torque
- Radio frequency heating
- Image artifacts

The biomaterials utilized in Medtronic ossicular implants include Polycel®, Hydroxylapatite (H/A), H/A-coated Polycel, platinum, titanium, stainless steel, fluoroplastic and Flex H/A. Due to the variety of materials used in otologic implants and the variety of MR conditions to which they may be exposed, it is difficult to provide a concrete statement that would cover all materials and conditions. In reviewing the Medtronic and available published literature regarding MR compatibility, the following conclusions can be made.
MRI Compatibility of Medtronic Otologic Prostheses

<table>
<thead>
<tr>
<th>Material</th>
<th>MR Safe</th>
<th>MR Unsafe</th>
<th>MR Conditional</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polycel</td>
<td>X</td>
<td></td>
<td></td>
<td>Based on scientific rationale¹</td>
</tr>
<tr>
<td>Hydroxylapatite</td>
<td>X</td>
<td></td>
<td></td>
<td>Based on scientific rationale¹</td>
</tr>
<tr>
<td>H/A-Polycel</td>
<td>X</td>
<td></td>
<td></td>
<td>Based on scientific rationale¹</td>
</tr>
<tr>
<td>Platinum</td>
<td></td>
<td>X²</td>
<td></td>
<td>Based on test data³,⁴,⁵</td>
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<tr>
<td>Titanium</td>
<td></td>
<td>X⁶</td>
<td></td>
<td>Based on test data³,⁴,⁵</td>
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<tr>
<td>Stainless steel</td>
<td></td>
<td>X⁷</td>
<td></td>
<td>Based on test data³,⁴,⁵</td>
</tr>
<tr>
<td>Fluoroplastic</td>
<td>X</td>
<td></td>
<td></td>
<td>Based on scientific rationale¹</td>
</tr>
<tr>
<td>Flex H/A</td>
<td>X</td>
<td></td>
<td></td>
<td>Based on scientific rationale¹</td>
</tr>
</tbody>
</table>

1. Material is non-conducting or a nonmagnetic item and poses no known hazards in all MR environments.
2. Testing has shown that platinum is suitable when tested in a 1.5 and 4.7 Tesla environment.
6. Testing has shown that titanium is suitable when tested in a 4.7 Tesla environment.
7. All stainless steel shows some degree of magnetism ex vivo, but not clinically significant in vivo.

Based on the available data, Medtronic ENT ossicular prostheses can be categorized as follows:

**MR Safe:** Polycel, H/A, H/A-Polycel, Flex H/A, and fluoroplastic

**MR Conditional:** Platinum, titanium, and stainless steel are safe in magnetic fields 3.0 Tesla or less.
In 2009, Medtronic otologic implants will be packaged with an MRI card that may be given to the patient.

Sincerely,
Medtronic ENT Regulatory Affairs
Rev.7/09
Additional articles that may be of interest:

1. **Effects of Magnetic Resonance Imaging Fields on Stapedectomy Prostheses**  

2. **Interaction between Magnetic Fields and Metallic Ossicular Prostheses**  

3. **Imaging of Ossicular Prostheses**  

4. **Magnetic Resonance Imaging of Stapes Prostheses**  

5. **Magnetic Prosthesis Displacement in High Strength Magnetic Fields**  
   Michelle D. Williams, M.D., Patrick Antonelli, M.D., et al., presented at the American Otological Society Annual Meeting, May 12-13, 2000 [pending publication].

6. **The Effect of Nuclear Magnetic Resonance Imaging on Metallic Middle Ear Prostheses**  

7. **Middle Ear Prosthesis: Significance of Magnetic Resonance Imaging**  

8. **Metallic Otologic Implants: in vitro Assessment of Ferromagnetism at 1.5T**  

9. **Further Studies on the Effects of Magnetic Imaging on Middle Ear Implants**  

10. **The Interactions Between Metal Stapes Prostheses and High-Intensity Magnetic Fields During Magnetic Resonance Tomography**  

11. **MRI Compatibility Issues in Otology**  