MRI & Cochlear Implants: Superior MRI Safety

With an ever-increasing use of MRI, there’s essentially a 100% likelihood a person will at least one, if not multiple, MRI scans in their lifetime. In fact, in just the United States, more than 100,000 MRI scans are performed every day.

That means every cochlear implant will very likely end up inside the powerful magnetic field of a high-field MRI scanner. It might be a routine knee scan a few months after implantation, or an emergency spine MRI following a car accident years from now, but that day is coming. That’s what makes MRI safety such an essential consideration for every single cochlear implant recipient.

Unfortunately, many cochlear implants carry a significant risk of complications during MRI, including pain, discomfort, and magnet dislocation. Why is there such a risk? The answer is simple—it comes down to the design of the implant’s internal magnet.\(^1,2,3,4,5,6,7,8,9\)

For more than 20 years, we have engineered our cochlear implants to offer exceptional MRI safety. Our cochlear implants enable immediate and reliable access to MRI scans for both recipients and clinicians. With MED-EL, your patients can have MRI where they need it, when they need it.

Why is this so important for you and your patients, as well as radiologists and other clinicians?\(^1,6,9\)

- Safe, comfortable MRI scans
- Immediate access to MRI
Let's look at what makes MED-EL implants the right choice for safe, reliable access to MRI scans.4,5,6,9

And if you're looking for our detailed MRI instructions, you can always find the full MRI conditions for all MED-EL implants at medel.com/isi.

**Powerful Magnetic Fields**

First, let’s look at the design of MRI machines. As the name implies, every magnetic resonance imaging scanner has very powerful magnets. These are static magnets, which means they’re usually always at full magnetic force. Those static magnets are incredibly strong—a 3.0 Tesla magnet is strong enough to lift a car.

Right now, 1.5 Tesla is the most common field strength, but high-resolution 3.0 Tesla scanners are quickly gaining popularity and may already be the only option in a number of clinics.

Now, let’s look at cochlear implants. Every cochlear implant has an internal magnet to hold the implant coil in place. With many implants, a simple axial magnet is used. An axial magnet is like refrigerator magnet; north is one side, south is on the other side.

Generally, the “head” end of a scanner is the **main magnet’s north or south pole**, with the opposite pole centered at the entrance of the scanner. An implant lies flat against the skull, so that axial implant magnet is oriented perpendicular to the main static magnetic field of the scanner.

As a patient enters the scanner, the implant magnet will attempt to align to this powerful field, so this 90° offset can cause significant torque force that pulls on the magnet. This powerful torque force is the main challenge for MRI scans with a cochlear implant.

**Soft Silicone Pocket**

Currently, most other manufacturers use a “soft-silicone pocket” design. This concept uses a thin lip of silicone around the rim of an exposed axial magnet for retention. This design is intended to allow the magnet to be surgically removed before an MRI scan.1,2

Unfortunately, it also often allows the magnet to be unintentionally removed during a scan by the magnetic force of the MRI scanner. During a scan, the magnet will attempt to twist out of the pocket to align with the magnetic field of the scanner. The soft silicone pocket only partially covers the magnet and provides only minimal resistance to magnet dislocation.3,4,5,6,7

Magnet dislocation is an alarmingly frequent issue. To reduce the rate of dislocation, other cochlear implant manufacturers require that the magnet must either be surgically removed or a rigid splint system and tight head bandage must be applied over the implant before any 1.5 Tesla scan.1,2

The rigid splint puts pressure against the skin above the magnet to resist the forces of dislocation. However, this doesn’t reduce the magnetic torque. The magnet can still attempt to align to the magnetic field. This can create highly concentrated pressure against the skin pinched between the rigid splint and magnet.
If an axial magnet is not securely imbedded, it can be dislocated by the powerful magnetic field of the MRI scanner. Magnet dislocation can cause the magnet to tilt up to 90° on edge to align with the north-south field of the scanner.

Even without full magnet dislocation, the severe pain and discomfort of this pressure can make it impossible to complete an MRI scan. And with a rigid splint in place, these magnets can still dislocate during a 1.5 Tesla MRI, which can cause extreme pain and may require unplanned surgical intervention to relocate or replace the magnet.

Furthermore, during intentional or unintentional magnet removal, the thin silicone pocket could possibly tear, damaging the implant and necessitating complete explantation and reimplantation of the entire implant. Walker et al. (2018) describes this issue with soft silastic pocket designs as “a potentially debilitating and costly complication of pursuing magnet removal.”

With this inherent risk of magnet displacement or dislocation, complications are common with soft-silicone pocket designs. These complications are well documented, with overall complication rate during 1.5 Tesla scans ranging up to 30–55%. This may deter clinicians from performing the MRI, which could delay effective diagnosis or treatment. In case of an emergency, such as a car accident, immediate access to MRI can be seriously impeded.

Your patients may not need an MRI every day, but would you trust a car seatbelt with a 30–55% failure rate?

Secure Magnet Retention

Remarkably, these complications are not an issue with MED-EL hearing implants, including our cochlear implants from more than 20 years ago. How is this possible?

At MED-EL, we’ve always made safety and reliability our priority. We have always used secure implant
magnets—making magnet dislocation practically impossible. Currently, we use three secure magnet designs for our portfolio of hearing implants. All three of these designs offer safe, reliable access to MRI without any risk of magnet dislocation.

Let’s start with our cochlear implants. For more than 20 years, our cochlear implants have used an axial magnet that is securely imbedded in a stiffening ring inside the coil.

Inside of an MRI scanner, this design evenly distributes any magnetic torque across the full surface area of the implant coil, which avoids any painful focused pressure. A simple head bandage should be used to help minimize any movement.

- **CONCERTO, SONATA, PULSAR, C40+, C40**
- 1.5 Tesla MRI without pain or discomfort
- No risk of magnet dislocation
- Immediate return to hearing after scan
In a recent study reviewing MRIs and cochlear implants, MED-EL recipients were the only group of cochlear implant recipients able to complete MRIs without pain, discomfort, or complications.\textsuperscript{4,10}

Our BONEBRIDGE Active Bone Conduction Implant and VIBRANT SOUNDBRIDGE Middle Ear Implant VORP 503 both use a secure, force-balanced magnet that enables comfortable 1.5 Tesla MRIs. Both of these implants are designed to avoid any torque-related movement in an MRI, so no head bandage is needed.

- BONEBRIDGE BCI 601 & SOUNDBRIDGE VORP 503
  - 1.5 Tesla MRI without pain or discomfort
  - No risk of magnet dislocation
  - No head bandage needed
  - Immediate return to hearing after scan

And then we have the latest breakthrough in MRI safety: SYNCHRONY.

3.0 Tesla MRI Safety

Our SYNCHRONY cochlear implant is designed to safely provide immediate access to 1.5 & 3.0 Tesla MRI at any time. With a revolutionary diametric magnet design, SYNCHRONY eliminates the negative effects of magnetic torque on the implant magnet, even at 3.0 Tesla. The rotatable diametric magnet self-aligns to the magnetic field of the scanner, so there’s no uncomfortable force on the implant.\textsuperscript{9}
SYNCHRONY’s diametric magnet can rotate and self-align inside of a secure titanium housing. Furthermore, the exceptionally secure magnet is practically impossible to accidentally dislodge. If you need clear imaging of the brain directly adjacent to the implant, the SYNCHRONY magnet can optionally be safely and easily removed.\textsuperscript{11,12}

Inside of an MRI scanner, SYNCHRONY’s magnet rotates to align with the main static magnetic field, so there’s practically no magnetic torque force.

For 1.5 or 3.0 Tesla scans with SYNCHRONY, there’s no need for magnet removal, rigid splints, or
even head bandaging. Your patient simply removes their audio processor for the scan, while the radiologist follows a few simple precautions. Your patient can return to using their audio processor right away after leaving the scanning room.9

- SYNCHRONY Cochlear Implant
- 1.5 Tesla & 3.0 Telsa MRI without magnet removal
- No risk of magnet dislocation
- No head bandage needed

**Peace of Mind**

Looking forward, your patients will all need safe, reliable access to MRI scans. And they rely on you to help them make the best-informed decision they can. With MED-EL, you can help ensure they’ll have safety, comfort, and peace of mind for years to come.

- No surgery
- No discomfort
- No hearing downtime

This simplicity offers more than convenience; it provides much greater safety and security for your patients and fellow clinicians, while ensuring immediate access to essential diagnostic imaging.

With MED-EL, your patients can have MRI where they need it, when they need it.

**Subscribe & Share**

Looking for more information on MRI with MED-EL hearing implants? Check out our step-by-step MRI guides for cochlear implants and for SOUNDBRIDGE & BONEBRIDGE.

Want first-hand perspective on MRI with SYNCHRONY? Check out this fascinating MRI case study: “Our patient and device have undergone seven MRIs of the head, C spine, and T spine without any issues or demagnetization to the device while still providing quality images.”

Have a radiology question about MED-EL hearing implants? Contact your local MED-EL office or let us know with our simple contact form.

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* Recipients with MED-EL cochlear implants may be safely MRI scanned when following the specific conditions for each implant detailed in the instructions for use.

**Not all products, indications, and features shown are available in all areas. Please contact your local MED-EL representative for more information.

References

10. These figures represent the percentage of recipients in the study who experienced discomfort, pain, or other complications during 1.5 T MRI (two 3.0 T scans were excluded from the figure). Kim et al. (2015) is a retrospective study looking at 1.5 T and 3.0 T MRI scans performed on CI recipients between 2003 and 2014. The study included 18 individuals; 5 recipients had Advanced Bionics devices, 11 had Cochlear devices, and 3 had MED-EL implants. Advanced Bionics recipients had 9 total 1.5 T scans; Cochlear recipients had 12 total 1.5 T scans and 2 total 3.0 T scans; and MED-EL recipients had 8 total 1.5 T scans.