# Guidance for out-of-hours (OOH) implant MR safety assessments

## Introduction

MRI departments often perform scans outside the typical Mon-Fri 9am-5pm office hours (times outside Mon-Fri 9am-5pm office hours are referred to as out-of-hours (OOH) in the rest of this guidance document). When scanning OOH there is often less MRI Physics or Radiologist support available which can present a challenge when a patient presents with an implant. What follows is some general guidance for managing these situations.

Please note that if an implant is known in advance and has been assessed prior to booking, it should be stipulated in the booking notes/event comment if this is safe to scan OOH and so this guidance is not applicable. This guidance is primarily aimed at aiding the assessment of MRI safety for patients referred for an OOH emergency scan.

This document may also be useful when an out-patient attends for an OOH MRI scan and declares an implant that has not been included in the referral and therefore has not been investigated prior to booking. However, in this scenario please remember that the impact of delaying a scan is likely to be reduced.

This guidance is focused on implants only and so does not cover pregnancy, skin patches, dressings, piercings, devices connected to the patient (e.g. monitoring equipment), or any other non-implant MRI safety concerns.

Where the guidance refers to Radiographer training, experience or competence to perform a task, we acknowledge that this is handled differently at different sites. Some may have a formal signoff procedure whereas others may be less formal and rely on the individual's professional judgement over whether they have the required training, experience or competence to perform the task or assessment.

## Active vs. Passive implants

Implantable medical devices can be split into two main categories:

- Active implants: these are implants that contain metallic components and require an energy source (electrical, mechanical or pneumatic) to function. We also include any implants that contain magnets as active implants. Examples include pacemakers, defibrillators, neurostimulators, cochlear implants and drug pumps.

- Passive (or non-active) implants: these implants require no power source for their function. Examples include hip/knee joint replacements, heart valves, aneurysm clips, coronary stents and breast implants.

## Guidance

Due to the variable nature of this scenario, the following list is not a step-by-step guide. Please consider the full list as a variety of approaches that can be used when appropriate to each specific scenario. A general flow diagram for dealing with implants OOH follows this guidance.

1. If you are uncertain whether a scan is safe to proceed, do not proceed until you have assured yourself it is safe. Seek advice from colleagues (Radiographers, Radiologists or MRI Physicists where available) or resources such as the NHS GG&C MRI Physics website: https://www.mriphysics.scot.nhs.uk/.
2. Non-emergency patients with known active implants will generally be booked within normal office hours (Mon-Fri 9am-5pm). If an active implant has been scheduled OOH then it should be booked at a time when there are appropriately trained staff to support the scan.
3. If an active implant is identified when a patient arrives for an OOH MRI scan, the default position should be to delay their scan until the implant has been investigated i.e. for booked out-patients, the patient should be sent away and rebooked once the implant has been investigated. Some exceptions to this are contained in the guidance below.
4. If an urgent MRI referral of a patient with an active implanted device is requested to be scanned OOH, the MR radiographer can refuse/decline to scan if mandatory requirements are not met. These include:
    a. If an active implant **requires a dedicated team** and that team is not available to perform the MR safety checks (e.g. cardiac physiologists to switch the pacemaker into MR safe mode and monitor the patient). There is currently no service provision for staff working outside Radiology to support scanning OOH and so patients with active implants such as pacemakers and neurostimulators (e.g. DBS & VNS) are highly unlikely to be able to get an MRI scan OOH.
    b. All active implants that **require specific MR kits**, intended to prevent implant magnet dislodgement and for which an MR kit is not available (e.g., certain cochlear implants) or if there are no staff available with sufficient experience in using the MR kit.
    c. If the MR radiographer **has not been trained on how to comply with the MR Conditions** (e.g. scanning with SAR or B1+rms limits lower than Normal Operating Mode)

   d. Active implants that **have an exclusion zone that includes the body area to be scanned**
   e. Active implants with **MR Conditions that we cannot follow** for whatever reason
   f. Active implants with **unknown or unclear MR Conditions**
5. Implantable infusion pumps (e.g. baclofen) may require the medication to be emptied before the scan. The make and model and corresponding MR Conditions must be checked and adhered to. It is not expected that an implantable infusion pump would be able to be scanned OOH, especially if the implantable infusion pump was not known about and investigated prior to booking. Please note that it is important to discuss the impact of emptying the pump with ward staff, where this is a requirement.
6. However, please note Programmable Shunts can be scanned OOH if all the criteria below can be satisfied:
   a. There is positive confirmation of manufacturer and MR conditionality of the programmable shunt. If make and model are not documented, imaging could be reviewed to identify shunt - contact the on call neuroradiologist.
   b. For shunts that require pre and post MRI shunt checks, there must be a dedicated neurosurgical team available to do the shunt checks.
   c. All the MR Conditions are addressed and understood by the MR radiographer.
7. Baha Connect and Baha Attract Hearing Implants can be scanned OOH if:
   a. The sound processor is removed before entering the MR scanner.
   b. All the MR Conditions are addressed and understood by the MR radiographer (including field strength as the BAHA Attract system is MR Conditional for 1.5T only)
8. Loop recorders can be scanned OOH as per guidance on the NHS GG&C website Implantable Loop Recorders (ILRs) or Insertable Cardiac Monitor (ICMs) – NHS GGC MRI Physics
9. If a patient reports that they have recently swallowed a PillCam, please follow the guidance on the NHS GG&C website Pill cam – NHS GGC MRI Physics
10. Similarly, please follow the Glucose Monitor guidance on the NHS GG&C website Glucose Monitors – NHS GGC MRI Physics
11. Some active implants include a condition to use a Transmit/Receive (T/R or TxRx) coil. If you are unsure if your coil is a T/R coil then do not proceed with the scan until you have confirmed which coils are T/R. Most head coils are receive only coils. The INS has a T/R head coil, the SOP for the use of this coil can be found in the Appendices (Appendix 1: Using the Transmit Receive coil (T/R coil), Appendix 2: Removal of spine coil & Appendix 3: Re-fitting the spine coil). At other sites, the knee coil is often a T/R coil but most/all others are receive only coils.
12. Passive implanted devices can be scanned OOH if:
   a. The passive implant is known to be MR Safe.

b. The passive implant is covered by a GISP (checking the inclusion and exclusion criteria). If the GISP does not state any post-implantation wait period (e.g. 6 weeks) then it is safe to scan immediately post-implantation. If the implant is within a post-implantation wait period stated within the GISP then a Radiologist is required to make a risk-benefit decision
c. The passive implant is known to be MR Conditional and the conditions can be met OOH. This is especially important with regards to RF heating, i.e. SAR or B1+rms limits. If the radiographer is not sure how to comply with the conditions and/or does not understand the conditions, they must not perform the scan. The scan should be rescheduled for standard office hours to ensure sufficient support to follow the MR conditions.
d. If an implant is not covered by a GISP and their MR Conditions include a post implantation wait period (and the implant has been implanted within that period) then it would need a Radiologist to make a risk-benefit decision
e. All the MR Conditions are understood by the MR Radiographer and adhered to.

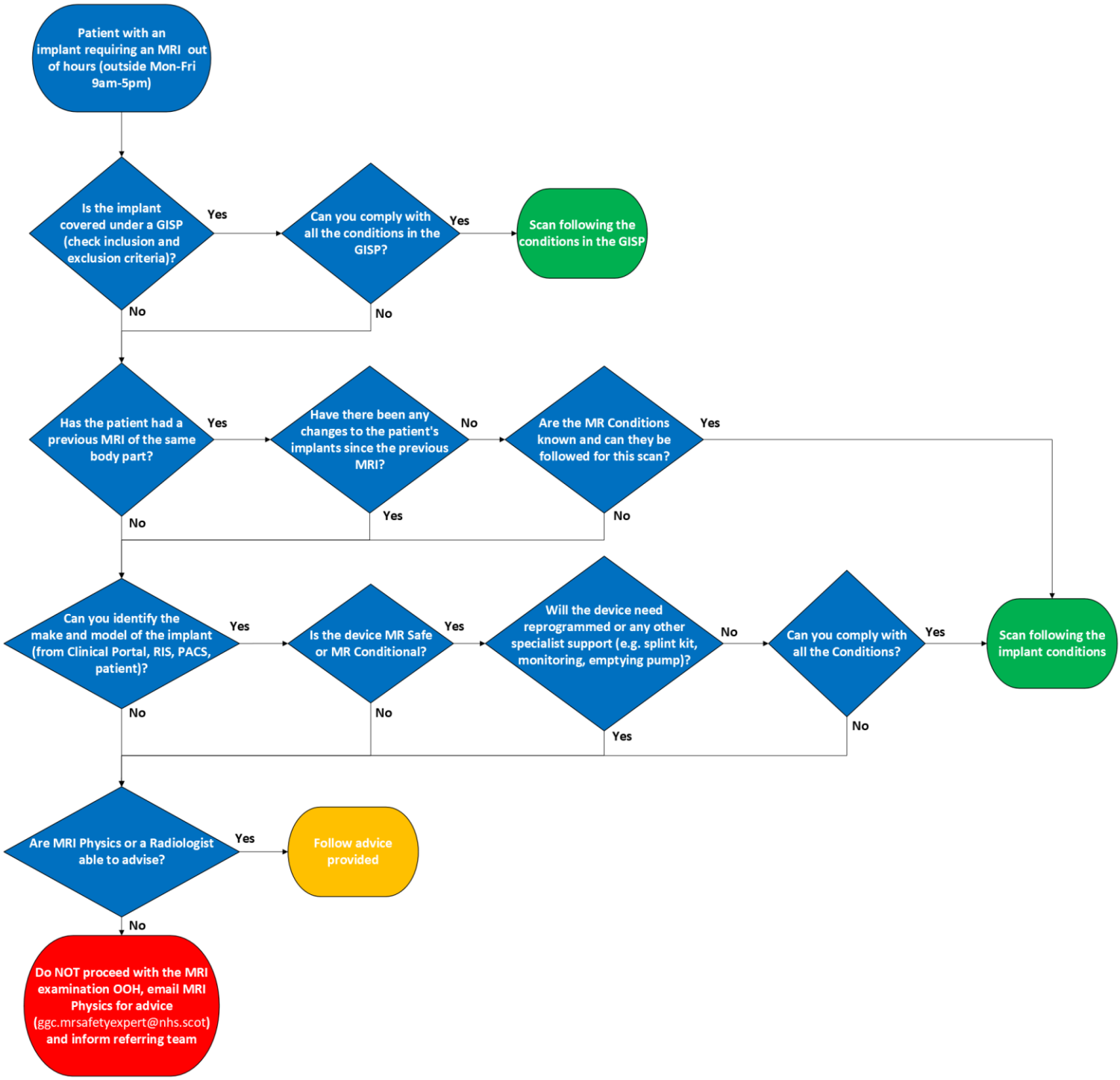
13. Particular care must be taken with aneurysm clips. If the make and model are not provided by the referrer or clearly documented elsewhere then it is unlikely to be able to be scanned out of hours. If an experienced Radiographer is able to find the documented proof of the make and model, confirm if it is MR Conditional and confirm that all the conditions can be met, then the scan can go ahead. Otherwise, do not proceed with the scan.
14. Separate guidance is provided for dealing with metallic foreign bodies Metal Objects and Foreign Bodies – NHS GGC MRI Physics and Orbital Foreign Body – NHS GGC MRI Physics
15. Do not assume if a patient has had a previous MRI that they will be safe to scan again. This might have been performed under strict conditions, or following a risk-benefit decision, the implant may have been changed since the previous MRI (e.g. shunt revision or pacemaker generator change) or the implant may have been missed and the patient fortunate to not have suffered an injury.
16. However, if a patient has had a previous MRI before, there may be information on CRIS to help inform the MRI safety assessment for the current MRI request:
    a. Check **CRIS alarms**
    b. If the patient has had a previous MRI, **check if all the implants were implanted at that time, if the implants were known and that there have been no changes to the implants** since the previous MRI
    c. Check the **Event Comments** to see if the safe scanning conditions are clearly documented. Consider whether they apply to the current request and

whether they can be met OOH (taking into consideration all the information contained in the rest of this guidance document)

d. Please note that the conditions in the Event Comment may only refer to conditions when scanning the area of interest in that request and **conditions may differ if scanning elsewhere in the body**
e. Please also note that the conditions in the Event Comment **may only refer to the Radiology conditions** (i.e. they may not explicitly state that a pacemaker will need to be reprogrammed by a Cardiac Physiologist)
f. Please also note that the conditions in the Event Comment **may have since been updated by the manufacturer**. If possible, check the latest MR Conditions on the implant manufacturer's website.
g. If the previous MRI scan proceeded after a risk-benefit assessment then a **new risk-benefit assessment will need to be performed** for the current MRI scan

17. If a patient lacks capacity or is otherwise unable to provide a full clinical history, please follow the separate process for these patients Patients with incomplete medical history – NHS GGC MRI Physics

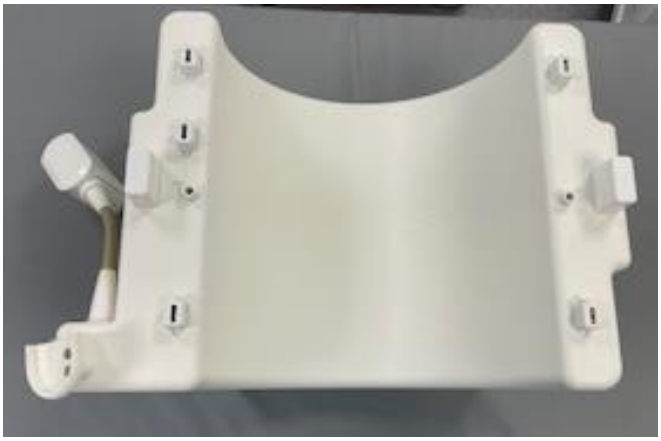
## Flow diagram



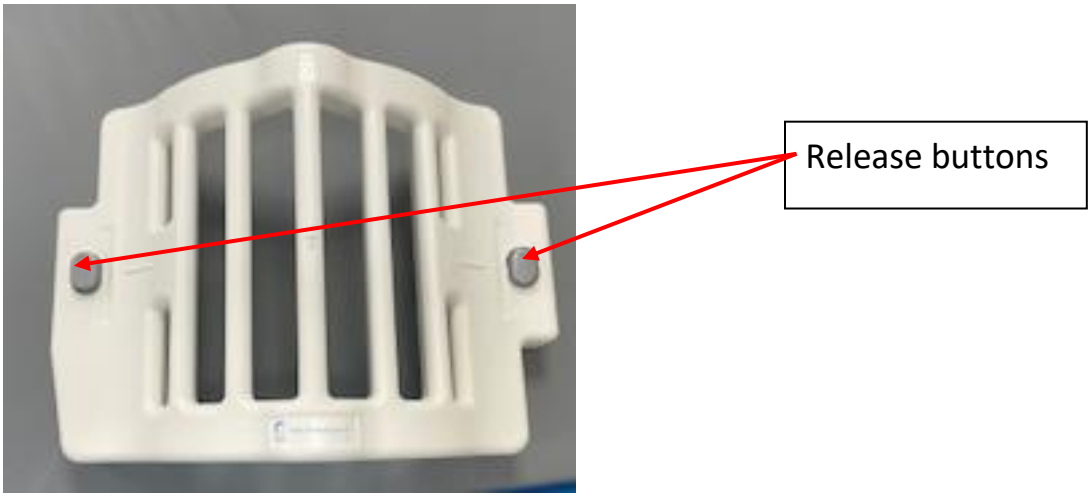
## Appendix 1: Using the Transmit Receive coil (T/R coil)

The INS has 2 Transmit Receive coils, one for the 1.5T and another for the 3T. Both are kept in the white coil cabinet in their respective room. They come in 2 parts:-

The Base (which is positioned onto the table):-



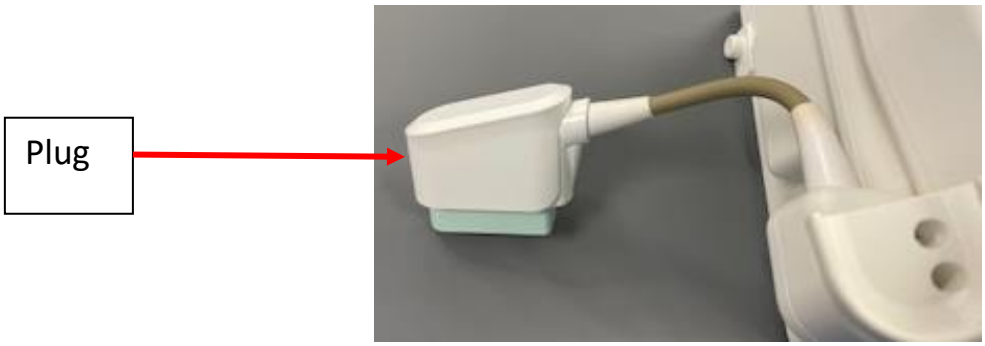
The front:-




The front section can be released by pressing down on the 2 buttons either side of the coil.

There is also a picture, on the front section, to enable correct siting of the coil.

The T/R coil base is plugged into the table in the same way that the 32 channel base is plugged in. Initially the coil will register a missing element, but this should disappear once the top piece has been attached. The top piece does NOT need to be plugged in




USES

The Transmit receive (T/R) coil is used for Head MRI scans for patients who have certain types of active implants within their body (e.g. certain sacral nerve stimulators (SNS) or deep brain stimulators (DBS)). The T/R head coil is used to prevent RF being transmitted by the body coil over the implant. We have a 3T and a 1.5T T/R coil, but please check the safe scanning conditions as these may limit to scanning on the 1.5T.

Safe scanning conditions for these patient will include use of the T/R coil for head scanning and may mean that any MRI scanning of area out with the head would be 'off label'. This would mean that a risk benefit assessment would have to be undertaken by a Radiologist, with input from an MR Safety Expert and clinician, before a decision could be made to scan elsewhere within the patient. As the patient has an active implant there may be other scanning restrictions such as field strength, restriction to length of active scanning time, normal mode or reduced SAR or B1+rms restrictions.

Using the T/R Coil will stop the rest of the body being exposed to RF during scanning, but in order for the scanner to recognise this **the Spine coil must be removed** as shown in the Figure below (see Appendix 2 for how to remove the spine coil) prior to siting the T/R Coil:-

**If the spine coil is not removed, the T/R coil cannot be positioned in the head holder.**

Once removed, the head coil should be slotted onto the head section and plugged in:-


TR coil base plugged in

Once head coil is in position, the pads within the big cupboard in the 1.5T or on the shelves within the 3T should be used to fill in the gap the spine coil has left:-

Scanning with the T/R coil

- Implant Suite - The Siemens 'Implant Suite' (on the Sola) which can be used to automatically restrict the SAR or B1+rms to patients, unfortunately **does not work** with the T/R head coil. This means that if there are SAR restrictions lower than normal mode for an implant, the scan will need to be monitored by an MRI physicist or experienced radiographer.

- Protocols - The scanners have several protocols and sequences set up under **Head TxRx,** and these protocols (or sequences) should be **used when possible**. If there is not a protocol or sequence already set up for the T/R head coil that is required, a 'normal sequence' can be adjusted to be used with the T/R coil. This can be done by opening the resolution tab and then opening the acceleration tab and removing any acceleration parameters such as GRAPPA or compressed sensing**.** Removing acceleration will make the sequence significantly longer and possibly increase the signal available, so it may be possible to adjust parameters to reduce the scan time.

- It should however be noted that scan times are likely to be longer with the TR coil – which is undesirable for patients with a restriction on active scan time. **If all sequences cannot be acquired within an active scanning time restriction, help to prioritise sequences should be sought from the duty radiologist.**

- If sequences were acquired with acceleration this will not harm the patient or damage the implant, but there will be severe artifact on the images.

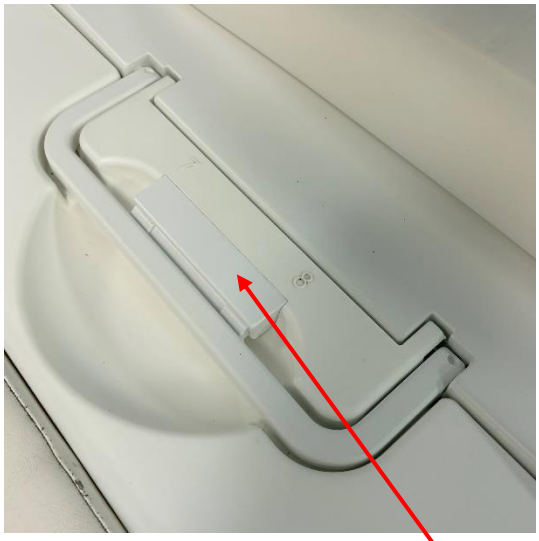
Once the examination has been completed, the T/R coil should be removed and the spine coil re-sited into the table (see Appendix 3).

Scanning at other sites

RHC is the only other site that has had their scanner reconfigured, so they can also use the INS 1.5T T/R coil. Should they require to borrow this, please ensure that the coil is packed up carefully in a box (in 3T equipment room), with padding around it, and safely transferred to RHC. Please ensure that this is returned to INS at the end of the working day, in case it is required OOH.

## Appendix 2: Removal of spine coil

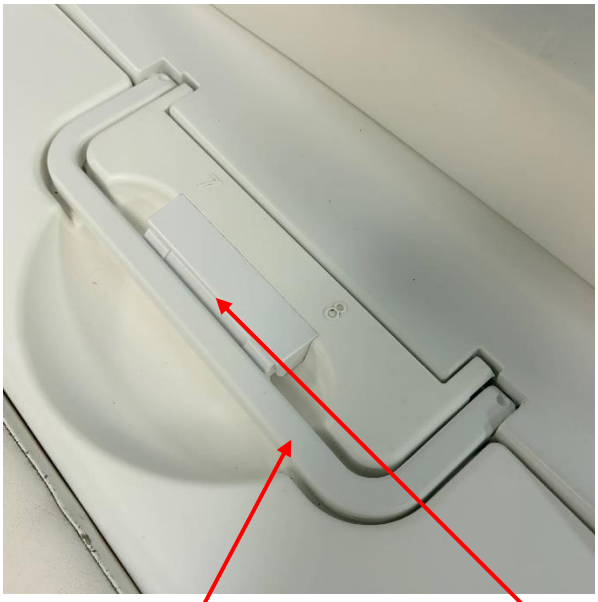
The lowest removable pad should be lifted, to reveal the spine coil connector:-

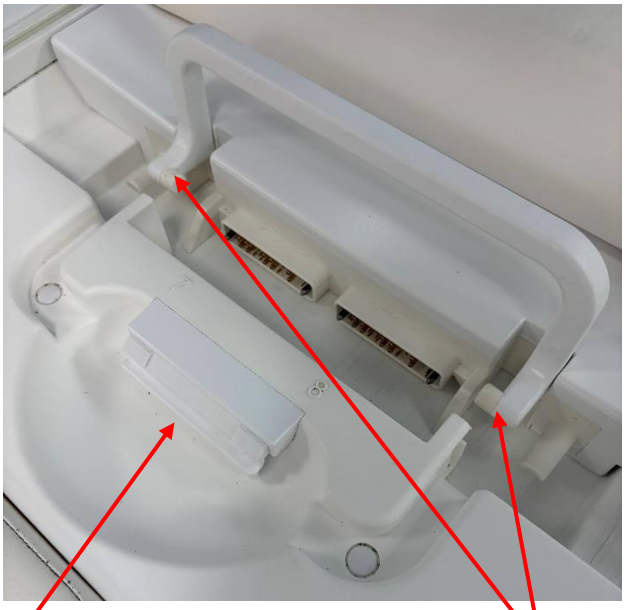



Lowest removable pad

Spine coil connector

The handle of the connector should be lifted, by pressing the release bar under the handle and lifting the handle:-





Spine coil handle

Spine coil release bar

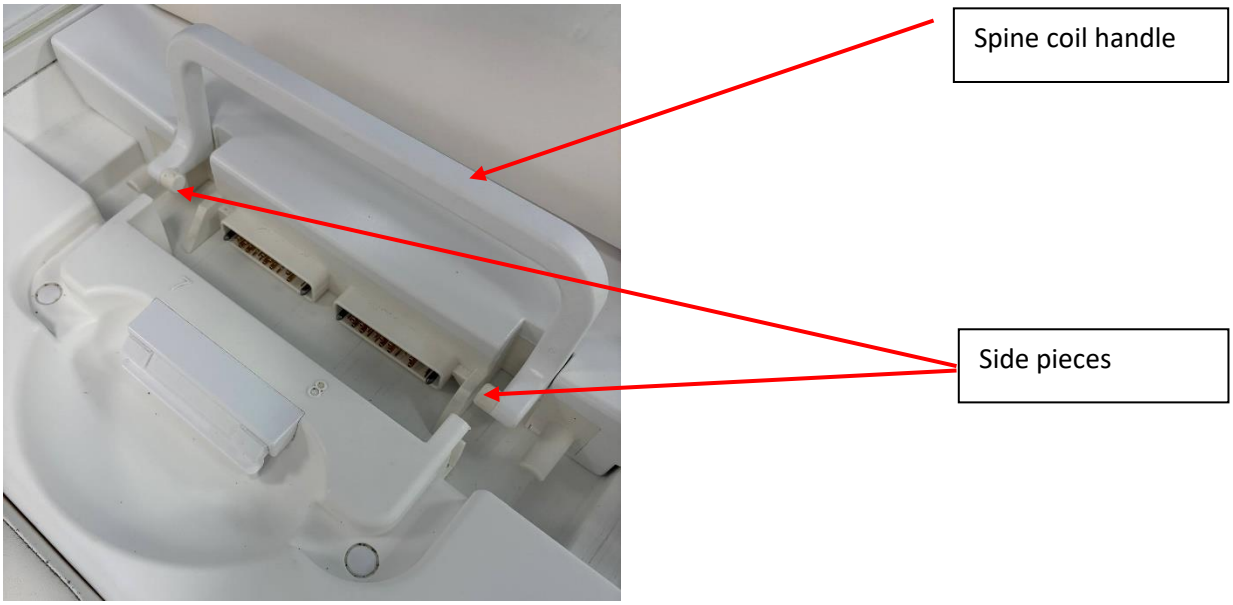
Side pieces

The spine coil can then be lifted by the handle to allow the side pieces to disengage.

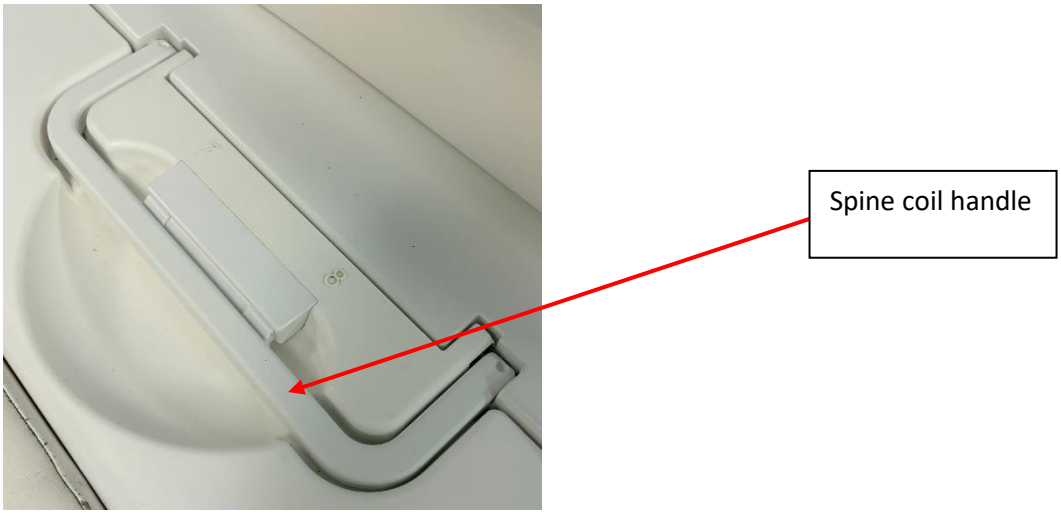
The spine coil can now be lifted off the table, using the handles, and placed carefully on a flat surface. **IT MUST NOT BE STOOD UP ON ITS EDGE**. Pads within the big cupboard in the 1.5T or on the shelves within the 3T should be used to fill in the gap the spine coil has left

## Appendix 3: Re-fitting the spine coil

Remove all the pads and place the spine coil on the table with the handle at the 'foot' of the table. Using the spine coil handle lift the spine coil to engage the side pieces




Once the side pieces are engaged the side handle can be pushed flat to engage the connectors. It will click into place and remain flat:-




Spine coil is now ready to use