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| Fitted face respirators (N95 / P2) and MRI compatibility: a review  |
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# Background

Magnetic Resonance Imaging (MRI) exams provide radiological diagnostic services through the use of the MRI machine. MRI machines utilise strong magnets and radio waves to create pictures from within the body5. Staff, patients, and families are not permitted into the MRI protected room if they are wearing, or in possession of any items containing (ferromagnetic) metal. Ferromagnetic material can be powerfully drawn towards the MR machine and/or can heat up considerably and have been known to cause burn injuries1,5.

It is understood that many N95/P2 masks contain ferromagnetic elements which may present a risk to patients, staff, and equipment. These elements include the malleable nose bridge, staples, the headband, and other materials including ferromagnetic nanoparticles.

Many manufacturers of N95 / P2 respirators have not provided readily available guidance on which respirators are MRI compatible. Furthermore, it can be difficult to determine whether ferromagnetic materials are contained within a respirator, even upon close inspection. Ferromagnetic materials may be sown into the respirator, concealed within other materials such as plastic, and nanoparticles are too small to be observed.

The strong ferromagnetic attraction between the MRI magnet and ferromagnetic components of a respirator may result in translational and torque forces being applied to the respirator2 which can result in the seal being breached if the respirator is lifted from the skin. Some ferromagnetic components may also heat up to a sufficient temperature and cause burns to patients faces.

Where MRI advice for products is provided by a manufacturer it will fall into 1 of 3 categories4:

* MRI safe – safe to be used within the MRI environment
* MRI conditional – safe to be used within the MRI environment under certain conditions
* MRI unsafe – not safe to be used within the MRI environment under any circumstances

# Research

A list of resources and information provided by other Australian and international health jurisdictions has informed the findings below.

# Findings

* Manufacturer advice (where provided) should be strictly adhered to.
* Staff working within the MRI environment should be fit tested with an MRI safe or MRI conditional respirator.
* P2/N95 Halyard Fluidshield respirators are considered MRI safe3
* The 3M Aura 1863 respirator is not MRI safe as it contains ferromagnetic staples3. Staples are found on other 3M respirator models so caution is advised when using other models as other models may also contain ferromagnetic staples and their MRI safety has not been verified.
* Staff fitted with an MRI conditional respirator should only enter the MRI room within certain conditions and should avoid close proximity with the MRI bore4.
* Staff should provide as much preparation for patients as possible prior to entering the MRI room to limit exposure time to the magnet.
* The risk profile of the patient must be considered before the patient undergoes an MRI. Where possible, patients who are high risk, suspected of, or are known to have COVID-19, should have their MRI postponed until they receive a negative COVID-19 test. Alternative forms of imaging should also be considered.
* If the MRI is critical then (if urgency allows), the patient should undergo the scan at the end of the list to allow cleaning and disinfection of the MRI room and equipment to avoid delays to other patients.
* If the SCOVID/COVID patient requires a time critical MRI and cannot be fitted with an MRI safe or MRI conditional respirator, then prior to entering the MRI room, the ferromagnetic strip should be removed, and tape applied to formulate a seal across the nose bridge6. It may not be possible to remove staples and maintain the integrity of the respirator seal.
* Wearing non-safe respirators within the MRI room is strongly discouraged, however if wearing a non-safe respirator is absolutely necessary for unanticipated reasons, then lowering the SAR value and/or shortening RF transmission duration and/or introducing cool down periods between scans may help to minimise injury6. It should be noted that these measures may prolong the study time for the patient.
* Utilising a magnetic field strength of 3T has a greater possibility of breaching the respirator seal than a magnetic field strength of 1.5T, although both strengths can potentially cause a breach in the seal.
* Patients with a tracheostomy should have an MRI safe mask placed over the tracheostomy6. In this instance, an N95 / P2 mask will not be able to achieve a seal as the respirator will not be applied to the face so a surgical mask may be used.

# References:

1. Therapeutic Goods Administration has issued [a safety alert for wearing of face masks during MRI exams](https://www.tga.gov.au/alert/use-face-masks-during-mri-examinations), <https://www.tga.gov.au/alert/use-face-masks-during-mri-examinations>
2. NHS. University Hospitals Birmingham, [Information on MRI safety of FFP3 Masks](https://covid19.sor.org/getattachment/Diagnostic-Radiography-FAQs/MRI/FFP3-Masks-MR-Safety-info-v3-1-24-Mar-20.pdf?lang=en-GB) <https://covid19.sor.org/getattachment/Diagnostic-Radiography-FAQs/MRI/FFP3-Masks-MR-Safety-info-v3-1-24-Mar-20.pdf?lang=en-GB>
3. Murray OM, Bisset JM, Gilligan PJ, Hannan MM, Murray JG. [Respirators and surgical facemasks for COVID-19: implications for MRI](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7138385/). *Clin Radiol.* 2020;75(6):405-407. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7138385/>
4. Alberta Health Services, [Recommendation for N95 Respirators in MRI](https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-ppe-di-mri-n95-recommendations.pdf), <https://www.albertahealthservices.ca/assets/info/ppih/if-ppih-covid-19-ppe-di-mri-n95-recommendations.pdf>
5. NSW Health. Information for medical imaging managers and clinicians – building capacity and protection during COVID-19 surge – Communities of practice Information for medical imaging managers and clinicians - building capacity and protection [during COVID-19 surge - Communities of practice](http://www.nsw.gov.au/) <http://www.nsw.gov.au>

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