**The assessment of motion artefacts in neuro-MRI**

**Descriptor:**

This template presents a method for the evaluation of motion artefacts in neuro-MRI examinations to determine if your neuroradiology department meets the RCR standard when they affect diagnostic accuracy.

**Background:**

Motion artefacts are common in magnetic resonance imaging, occurring in up to 59% of studies (Andre et al., 2015). The impact of such artefacts on the diagnostic accuracy of an examination depends upon their severity and the nature of the MRI technique (e.g. structural MRI versus advanced MRI techniques such as fMRI, DTI and perfusion imaging).

With conventional structural MRI sequences, minimal motion artefact is unlikely to impact on radiological interpretation but with increasing ghosting and blurring there becomes a greater probability of the sequence being rendered non-diagnostic. Motion artefact has been identified as the most common reason for an MRI sequence being repeated (Schreiber-Zinaman and Rosenkrantz, 2017), increasing the overall imaging time required per patient. This may impact on clinical service provision with financial implications (Andre et al., 2015).

Increased written information provided to patients prior to undergoing neuro-MRI has been shown to reduce the need for repeated sequences due to motion artefacts (Ali et al., 2013). There will however be a subset of patients with neurological disease for which unintentional movement during MR imaging cannot be avoided, this includes patients who may be acutely unwell (e.g with a stroke) or who have a chronic neurological disease such as those resulting in movement disorders which include chorea, dystonia or tremor.

Identification of the occurence of motion artefacts in patients with movement disorders (and other neurodegenerative disorders such as those resulting in dementia) is of particular importance as it could allow for additional measures to be introduced to maximise diagnostic accuracy of the MRI examination, avoiding the need for imaging under general anaesthesia.  These could range from simple steps such as reordering the imaging protocol to acquire the longer sequences first, to the implementation of rapid acquisition MRI sequences such as Wave-CAIPI (Bilgic et al., 2015).

The Royal College of Radiologists stipulates that all those involved in the reporting of imaging studies a) be able to evaluate image quality and b) to know to what extent artefact affects the diagnostic accuracy of an examination and whether a repeat is required or a caveat should be included in the report (Standards for interpretation and reporting of imaging investigations, 2nd Edition).

It is important that neuroradiology departments have a mechanism in place to ensure that MRI motion artefacts are kept to a minimum and when they do occur, that the RCR standard is met.

The objective of this audit is to determine if the RCR standard is met cases when artefacts are deemed to impact upon the diagnostic accuracy of the examination.The collected data may also offer the potential to reduce motion artefacts by identifying contributory factors which could lead to modification of the imaging technique.

## The Cycle

**The standard:**

For MRI examinations with motion artefact deemed sufficient to result in the possibility of diagnostic uncertainty, then the sequence(s)/examination are repeated and/or the artefact has been acknowledged in the radiology report.

**Target:**

100%

(Standards for interpretation and reporting of imaging investigations, 2nd Edition The Royal College of Radiologists)

## Assess local practice

**Indicators:**

1. Number/percentage of neuro-MRI examinations with motion artefact.
2. If present, number/percentage of the affected sequences with motion artefact with grades scored moderate to severe (see ‘Data items to be collected’ for definitions).
3. Of those from 2., the number/percentage where the RCR standard has been met.

**Data items to be collected:**

1. From the radiology information system (RIS), electronic health record system (EHRS) identify all neuro-MRI examinations (brain) performed in a defined preceding period (e.g 3 months).

exclusion = if performed under general anaesthesia

2. For all examinations record:

**General category** of indication e.g:

stroke/vascular, neuro-oncology, inflammation, infection, neurodegenerative (dementia), movement disorder, hydrocephalus/CSF, epilepsy, other

**Inpatient/outpatient** (if inpatient: whether ITU/critical care).

**Patient age**

**Notes on RIS**entered at time of imaging e.g. if patient distressed/agitated, involuntary movements.

3. Neuroradiologist(s) assessment for motion artefacts, using scoring criteria based upon those described by Andre et al., 2015 (see attached file: Data Collection and Assessment).

4. For those sequence(s)/examination with moderate/severe artefact, record:

a. if affected sequence(s)/examination have been repeated.

b. if artefact is acknowledged in report.

c. calculate % with a. or b. performed.

**Suggested number:**

All neuro-MRI examinations performed in a defined period (e.g. 3 months)

**Suggestions for change if target not met:**

1. Aim to present the results at the local clinical governance meeting to both neuroradiologists and radiographers.

For any sequence(s)/examinations not meeting the RCR standard present:

- the clinical features of these cases (indication/inpatient vs outpatient/patient age).

- any notes recorded on RIS.

2. Decide on methods to improve adherence to the RCR standard e.g.

- if motion artefact identified by the scanning radiographer, on-table neuroradiologist review of sequences to decide on need for repeat imaging.

- standardised reporting template with set phrases:

 presence of artefact = Y/N. If Yes: repeat imaging required = Y/N

3. For examinations with moderate/severe artefact, identify clinical features relating to subsets of patients affected e.g. those with movement and other neurodegenerative disorders, inpatient vs outpatient.

Discuss mechanisms to reduce the incidence of motion artefacts.

4. Repeat audit in 6 months.

This template can be extended to include spinal MRI examinations and used within other radiology subspecialties to assess whether the RCR standard is met.

**Resources:**

RIS, EHRS

[**data\_collection\_and\_assessment.pdf**](https://www.rcr.ac.uk/sites/default/files/audit_template/data_collection_and_assessment_1.pdf)PDF - 89.19 KB

**References:**

1. Ali, S.H., Modic, M.E., Mahmoud, S.Y., Jones, S.E., 2013. Reducing clinical MRI motion degradation using a prescan patient information pamphlet. Am. J. Roentgenol. 200, 630–634.
2. Andre, J.B., Bresnahan, B.W., Mossa-Basha, M., Hoff, M.N., Patrick Smith, C., Anzai, Y., Cohen, W.A., 2015. Toward quantifying the prevalence, severity, and cost associated with patient motion during clinical MR examinations. J. Am. Coll. Radiol. 12, 689–695.
3. Bilgic, B., Gagoski, B.A., Cauley, S.F., Fan, A.P., Polimeni, J.R., Grant, P.E., Wald, L.L., Setsompop, K., 2015. Wave-CAIPI for highly accelerated 3D imaging. Magn. Reson. Med.73, 2152–2162.
4. Schreiber-Zinaman, J., Rosenkrantz, A.B., 2017. Frequency and reasons for extra sequences in clinical abdominal MRI examinations. Abdom. Radiol. 42, 306–311.
5. [www.rcr.ac.uk/publication/standards-interpretation-and-reporting-imaging-investigations-second-edition](http://www.rcr.ac.uk/publication/standards-interpretation-and-reporting-imaging-investigations-second-edition)

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