*MR Physics & Techniques for Clinicians/*Artifacts to Artefacts: Causes & Cures from a Clinical Perspective

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Highlights:

- Identifying and rectifying artifacts often requires discussions between people in interdisciplinary backgrounds. Clinicians who can effectively communicate with other disciplines (technologists, MR manufacturer training specialists, development engineers within MR manufacturer organizations) usually solve their artifact problems quicker and to greater satisfaction.
- Pathology mimicking artifacts are much more problematic than easily identifiable artifacts.
- Artifacts can be categorized as either primarily due to phase or amplitude errors in the k-space acquisition.
- In general, strategies that minimize artifacts require more care in generating protocols and more scan time.

Target Audience: The presentation is aimed primarily at clinicians and clinician/scientists interested in growing their understanding of the causes and possible corrections for minimizing or eliminating image artifacts. Given the breadth of interdisciplinary researchers utilizing MRI in new ways each year, it is likely that some scientists would also benefit from the presentation. As quantitative MRI is growing in scope, image quality and performance problems that limit accuracy and precision will also be described. However, a quantitative, mathematical approach to describing artifacts and their correction will not be given.

Outcomes / Objectives: The presentation will aim to provide a framework by which learners can characterize artifacts. The hope is that the framework will provide 1) understanding of the role clinician/scientists play in identifying pathology mimicking artifacts during development of new MR methods 2) an approach to understanding and recalling artifacts causes and corrections, and 3) the physics behind the cause of imaging artifacts.

Often an image quality issue and/or artifact can't be resolved from looking at a single image or series of images. Often a type of "differential diagnosis" is needed for clinicians and their staffs to gauge likely artifact sources and rule out other artifact sources. This process of winnowing the source of the artifact cause helps the clinician limit the discussion to promising avenues of investigation and limits the size of the interdisciplinary team required to identify and rectify the artifact. The more focused and directed the investigation is, the more likely an effective solution will be derived quickly.

Methods: Sample methodologies to characterize artifacts and/or image quality concerns will be reviewed. As MR matures, often these methodologies are written from a clinical perspective in recent review articles from the standpoint of subspecialists in Radiology. For example, Hakky et al [1] has provided a review of MR artifacts for neuroradiology, Yitta et al has provided one for breast MRI [2], and Ferreira et al have provided one for cardiac MRI[3]. As limiting artifacts goes hand in hand with strong protocols, often these review articles simultaneously cover how good protocols limit artifacts. In musculoskeletal imaging, Shapiro et al has produced a review of the potential for advanced methods to produce artifacts in peripheral joints [4] while Elliott et al

focuses on the spine [5]. Postoperative MRI creates causes for additional confusion and artifact, especially when metal hardware is utilized in surgical repair [6].

High field imaging, particularly at 7T, brings great opportunities for improved image quality but also a plethora of new imaging artifacts. Many of the assumptions that simplify imaging throughout 1.5T MRI and 3T neuro and joint imaging no longer apply at 7T. Nearly all peer-reviewed publications describing the opportunities of high field imaging will also cover artifacts at high field as well [7]. An educational session with case-based studied of artifacts will focus on several high field artifacts in the Thursday session at ISMRM in Milan.

Wherever possible, those methodologies will be compared with codified processes by which major MR manufacturers utilize to resolve artifact and IQ problems. Whenever possible, the presentation will aim to describe artifacts of value to clinicians and clinician scientists of moderate prevalence. Artifacts likely to be explained in the first week of a MR training experience (e.g. phase wrap) will be avoided in favor of artifacts that are important but less prevalent. Artifacts occurring in a narrow spectrum of clinical care will be less emphasized.

The pressure put on Radiology organizations to consistently provide more information, often requiring more pulse sequences, in the same or less time has created demand for faster and faster scanning methodologies. Often the scan acceleration methodologies utilized to provide this productivity increases the likelihood of artifact and/or reduced image quality. Awareness on the sources of these potential problems can ultimately lead clinicians to better protocol designs that minimize day to day problems while minimizing the time to identify artifacts when they appear.

Results: Causes, possible solutions, and tradeoffs for each discussed artifact will be provided from an image-based perspective[8].

Conclusions: Clinicians play the key role in guiding imaging science researchers and MR manufacturers to devote limited resources towards the most pressing artifacts in clinical practice. Learning a rudimentary basis for understanding artifacts will make individual clinicians more influential in this advisory role. Learning effective methods by which clinicians can describe artifacts in an interdisciplinary environment will reduce the time needed to address image quality problems. These efforts ultimately produce more effective, productive, and higher quality radiology practices.

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