



Title	A quantitative experimental study of MRI image uniformity
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Abstract of Thesis

Name (Felemban Doaa Fared M)

Title

A quantitative experimental study of MRI image uniformity

(MRI画像の均一性に関する実験的検討)

Purpose: The goal of this study was to assess MRI image uniformity, by investigating several aspects projected to influence said uniformity, using a standardized method laid out by the National Electrical Manufacturers Association (NEMA).

Methods: Six metallic materials, (i.e. 1cm³ cubes embedded in a glass phantom), were scanned, [i.e. Au, Ag, Al, Au-Ag-Pd alloy, Ti and Co-Cr alloy], as well as a reference image without any embedded metallic material. Sequences included spin echo (SE) and gradient echo (GRE) scanned in three planes, (i.e. axial, coronal, and sagittal). Moreover, three types of surface coil, (i.e. HN, Brain, and TMJ coils), as well as two image correction methods, (i.e. SCIC, PURE), were employed to evaluate their respective effectiveness on image uniformity. Image uniformity was assessed using the NEMA peak deviation non-uniformity method.

Results: The results showed that TMJ coils typically elicited the least uniform image, and Brain coils outperformed HN coils when metallic materials were set. Additionally, when metallic materials were present, the SE sequence outperformed GRE, especially for Co-Cr, (which was most pronounced in the axial plane). Furthermore, both SCIC and PURE improved image uniformity compared to uncorrected images, and SCIC slightly outdid PURE when metallic metals were present. Lastly, Co-Cr elicited the least uniform image, while all the other metallic materials generally showed similar patterns across the board.

Conclusion: This study assessed MRI image uniformity by investigating several aspects expected to influence image uniformity during MRI scanning. It was found that the TMJ coil typically elicited the least uniform image compared to Brain and HN coils. When metallic materials were present, the HN coil slightly outperformed the Brain coil. Additionally, when metallic materials were set, the SE sequence slightly outdid GRE especially for Co-Cr (also for Ti) most noticeably in the axial plane. Next, both SCIC and PURE improved image uniformity compared to uncorrected images; and SCIC slightly outperformed PURE when metallic metals were present. Lastly, Co-Cr elicited the least uniform image while all the other metallic materials generally showed similar patterns across the board (which did not deviate significantly from images without metallic metals present).

It was concluded that a quantitative understanding of the various factors influencing image uniformity represented an important addition to optimizing image quality and clinical interpretation. This may possibly lead to the avoidance of image misinterpretation and consequently to improving overall image diagnosis.

論文審査の結果の要旨及び担当者

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論文審査の結果の要旨

本論文は、MRI 画像の均一性について実験的に検討したもので、受信用コイル、MRI 撮像シーケンス、撮像断面方向、および画像均一性向上フィルタを変化させながら MRI 画像の均一性を測定した。また、歯科で用いられる金属の存在下においても同様の検討を行った。

その結果、頭頸部コイルを用いてスピンエコー法による矢状断の MRI 画像が最も均一性が高く、チタンやコバルトクロム合金の存在下では、グラジエントエコー法を用いると均一性が損なわれることが明らかとなった。また、画像均一性向上フィルタの有効性が明らかとなった。

以上の結果は、口腔顎顔面領域の MRI 画像検査における撮像条件の最適化に有用であり、博士（歯学）の学位論文として価値のあるものと認める。