Metal artifact reduction algorithms for CT in the trauma setting: Do they take too long?

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INTRODUCTION

With the perpetual release of new, increasingly advanced CT reconstruction methods, we must provide feedback to vendors on what constitutes a clinically acceptable reconstruction time. To answer this question, we must determine whether reconstruction times are hindering the clinical workflow.

CT technologists at our institution complained that applying metal artifact reduction (MAR) increased reconstruction time. We set out to quantify the magnitude of this increase and evaluate its effect on CT exam times for trauma patients. This setting was chosen due to its time-sensitive nature.

PURPOSE

We quantify the increase in reconstruction time when employing metal artifact reduction (MAR) and analyze the impact on the duration of trauma exams at our institution.

METHOD

Our dataset consists of 127 patient exams performed on 5 CT scanners. We quantified reconstruction times using the Content Time DICOM tag of the first and last images. With and without MAR timing comparisons were performed with cervical-spine reconstructions of 1.25mm slice thickness and 0.625mm spacing. Reconstruction time per axial slice was calculated to account for differences in scan range.

Exam duration, defined here as time between first acquisition and completion of last reformat, was calculated using the Acquisition and Content Time DICOM tags. Durations were compared between exams in which MAR was employed in one or more reconstructions sent to PACS and exams in which MAR was never employed. A single trauma exam often fulfills multiple orders. Exam duration comparisons were limited to exams fulfilling the same number of orders.

RESULTS

Key Result 1: MAR increased reconstruction time per axial slice by 350%!

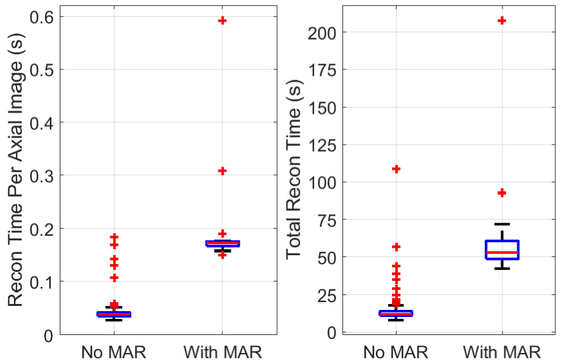

Figure 1: Reconstruction times with and without MAR for cervical spine reconstructions with 1.25mm slice thickness and 0.625mm spacing. (Left panel) Reconstruction time per axial slice. (Right panel) Total reconstruction time.

	No MAR Recon Time (s)	With MAR Recon Time (s)	p-value	Percent Increase
Per Axial Slice	0.039 [0.035,0.042]	0.173 [0.167,0.176]	<0.001	350%
Total	12.0 [11.0,14.0]	53.0 [48.5,60.75]	<0.001	342%

Table 1: Median and interquartile ranges (shown in brackets) for the reconstruction time data shown in Figure 1. P-values are reported for comparison of the No MAR and With MAR reconstruction time distributions using a right-tailed Mann-Whitney U test.

Key Result 2: Despite increased reconstruction times, we did not observe increased exam durations in trauma exams in which MAR was employed.

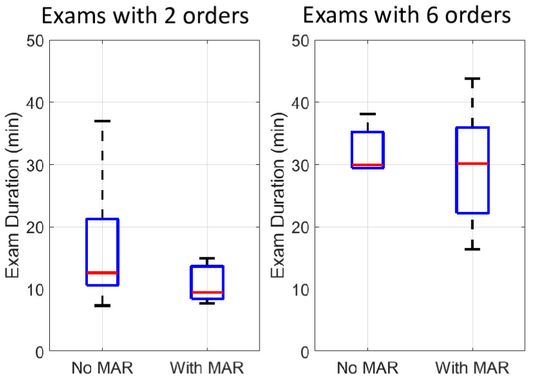

Figure 2: Comparison of exam durations for exams in which MAR was employed in at least one reconstruction to exams in which it was not employed. Results are shown for exams fulfilling 2 (left) and 6 (right) orders. Most trauma exams at our institution fall into these categories.

	With MAR Exam Duration (minutes)	No MAR Exam Duration (minutes)	p-value
2 orders	9.4 [8.4,13.6]	12.6 [10.6,21.2]	0.98
6 orders	30.2 [22.2,36.0]	29.9 [29.4,35.2]	0.65

Table 2: Median and interquartile ranges (shown in brackets) for the exam duration data shown in Figure 2. P-values are reported for comparison of the No MAR and With MAR reconstruction time distributions using a right-tailed Mann-Whitney U test.

RESULTS CONTINUED

Key Result 3: The time for all reconstructions is typically only on the order of 10-20% of the exam duration.

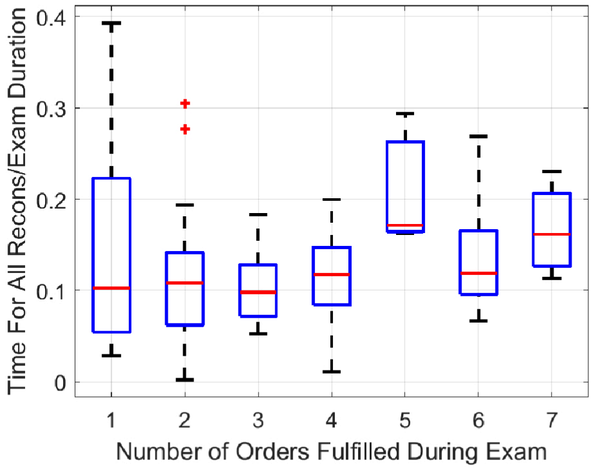

Figure 3: Total reconstruction time as a fraction of exam duration plotted against number of orders fulfilled during the exam.

CONCLUSIONS

MAR increased reconstruction time by as much as 350%, but we did not observe a corresponding increase in exam duration in the setting of trauma. We believe this is attributable to the short duration of reconstruction relative to total exam time, the fact that trauma exam durations are highly variable, and that technologists perform other tasks while images reconstruct.

CONTACT INFORMATION

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