Reducing Fluoroscopic Doses in Routine Musculoskeletal Joint Related Procedures

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Disclosure

No relevant financial relationships with the manufacturers or any commercial products discussed in this CME activity

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Background

- Given increased public concern about radiation exposure from imaging exams, radiologists are now presented with a unique challenge of reducing patient dose to levels as low as reasonably achievable (the ALARA principle) while maintaining diagnostic quality images

- In the last decade alone, there has been increased emphasis on patient radiation safety with new initiatives being implemented to help reduce dose with both clinical (i.e., change in imaging protocols specific to the patient or clinical indication) and technological (i.e., changes in hardware or software parameters) strategies in mind

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Background

- With new dose standards being developed by the Joint Commission, there is also a growing trend in integrating radiation dose within imaging reports in an effort to provide more transparency and accountability

- As a result, an increasing number of radiologists are becoming aware of dose variations between exams and across institutional sites

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Background

- In particular, staff and fellows in the Musculoskeletal Radiology Department at our institution have anecdotally witnessed fluoroscopic radiation dose discrepancies between sites during common musculoskeletal (MSK) procedures

- We operate two outpatient imaging sites with one site (Site A) consistently demonstrating higher dose rates relative to the other site (Site B)

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Objectives

- Given this discrepancy, the purpose of this quality improvement study was to:
  - Determine the cause for fluoroscopic dose variation between two different imaging sites at our institution
  - Implement new protocols, in a collaborative approach with our department technologists and physicist, to reduce or eliminate dose discrepancy
  - Re-evaluate dose rates at each site following protocol implementation to determine effectiveness in dose reduction
  - Educate our department staff, residents, and technologists on the importance of reviewing dose reduction techniques on a regular basis to allow effective management of patient dose, thereby improving quality of care

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Methods

- Two outpatient imaging sites were analyzed at the default manufacturer "low dose" settings
  - Site A: (Siemens Arcadis Varic) 237 consecutive MSK procedures
  - Site B: (Philips BV Pulsera) 626 consecutive MSK procedures
- Over a 3 month period (July 2014 - October 2014) the following variables were documented for all MSK joint procedures at Site A and Site B:
  - Type of procedure (Therapeutic hip injection, therapeutic shoulder injection, joint aspiration)
  - Dose rate (mGy/min)
  - Procedure time (Minutes:seconds)
- These measurements served as a baseline with Site B as the gold standard

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Methods

- After gathering the initial data a new protocol was devised at Site A in collaboration with our physics department. Modifications included the following:
  - Lowering frame rate from 8 to 4 frames/second
  - Reducing the target detector dose from "standard dose" to "reduced dose" ("reduced dose" setting not a default as part of manufacturer's standard "low dose" setting)
  - Retraining X-ray technologists to utilize the new protocols as these new modifications were not standard settings

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Methods

- Upon implementing the new protocols, 144 consecutive MSK joint procedures were analyzed at Site A over a 3 month period (October 2014 - January 2015)
- The following variables were again recorded:
  - Type of procedure (Therapeutic hip injection, therapeutic shoulder injection, joint aspiration)
  - Dose rate (mGy/min)
  - Procedure time (Minutes:seconds)

Results

Site A
Pre-intervention: average dose rate of 35.3 mGy/min
Post-intervention: average dose rate of 22.9 mGy/min
Corresponds to a reduction of 35%

Site B - Gold standard
Average dose rate of 5.0 mGy/min during this period

- Possible causes of lower dose rate
  - Absence of arthroplasty aspiration cases at Site B
  - Younger demographics at site B

Results

At Site A, procedures were further subcategorized

- Therapeutic hip injections: 31% average dose rate reduction
- Therapeutic shoulder injections: 56% average dose rate reduction
- Joint aspirations: 42% average dose rate reduction

All combined cases at Site A demonstrated a 19% average reduction in time

- Therefore image quality was not degraded to a level where diagnostic challenges arose

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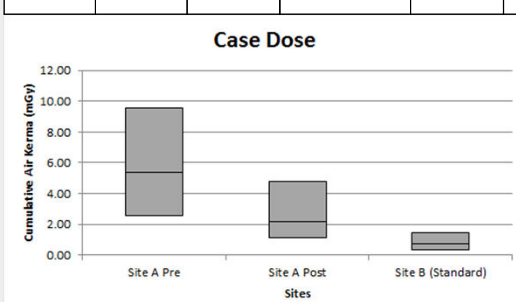
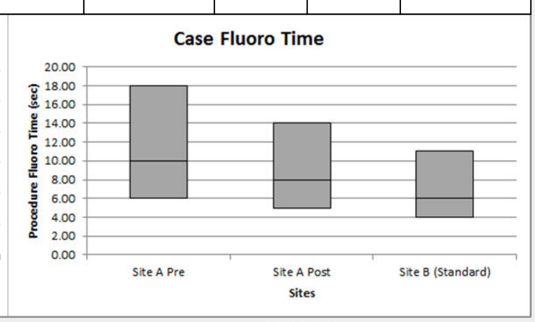
Results

	Air Kerma (mGy)			Time (sec)			Rate (mGy/min)		
	Site A Pre	Site A Post	Site B (Standard)	Site A Pre	Site A Post	Site B (Standard)	Site A Pre	Site A Post	Site B (Standard)
Count	237	144	626	237	144	626	237	144	237
Mean	8.14	3.75	1.38	14.43	11.71	9.51	35.33	22.92	5.02
SD	9.85	4.32	2.29	13.96	12.00	9.99	21.81	24.95	3.79
Min	0.30	0.14	0.01	1.00	1.00	0.00	4.22	0.34	0.40





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Discussion

- Target goal of >33% reduction in dose rate involving common fluoroscopic MSK procedures was achieved

- Implementation relatively easy, inexpensive, and fast
  - Onsite physicist able to modify hardware parameters and train technologists in <½ day
  - Although site A lacked proprietary “ultra-low dose feature” available at site B, simple baseline machine output parameters were manipulated, obviating need for potentially costly hardware/software upgrades

- Further reduction likely achievable as marginal image quality degradation did not affect procedural success rates or length

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Discussion

- “Active” dose reporting within radiology dictations allows for improved detection of dose trends and outliers

- Regular internal reviews of both current and historical trends of dose rates across varying institutional sites and fluoroscopy manufacturers should be conducted

- Subspecialty radiologists should work closely in collaboration with physicists and technologists to routinely review radiation dose rates and necessity of image quality based on indication (i.e., confirmation of intra-articular position versus cerebral angiography for aneurysm detection)

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References

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