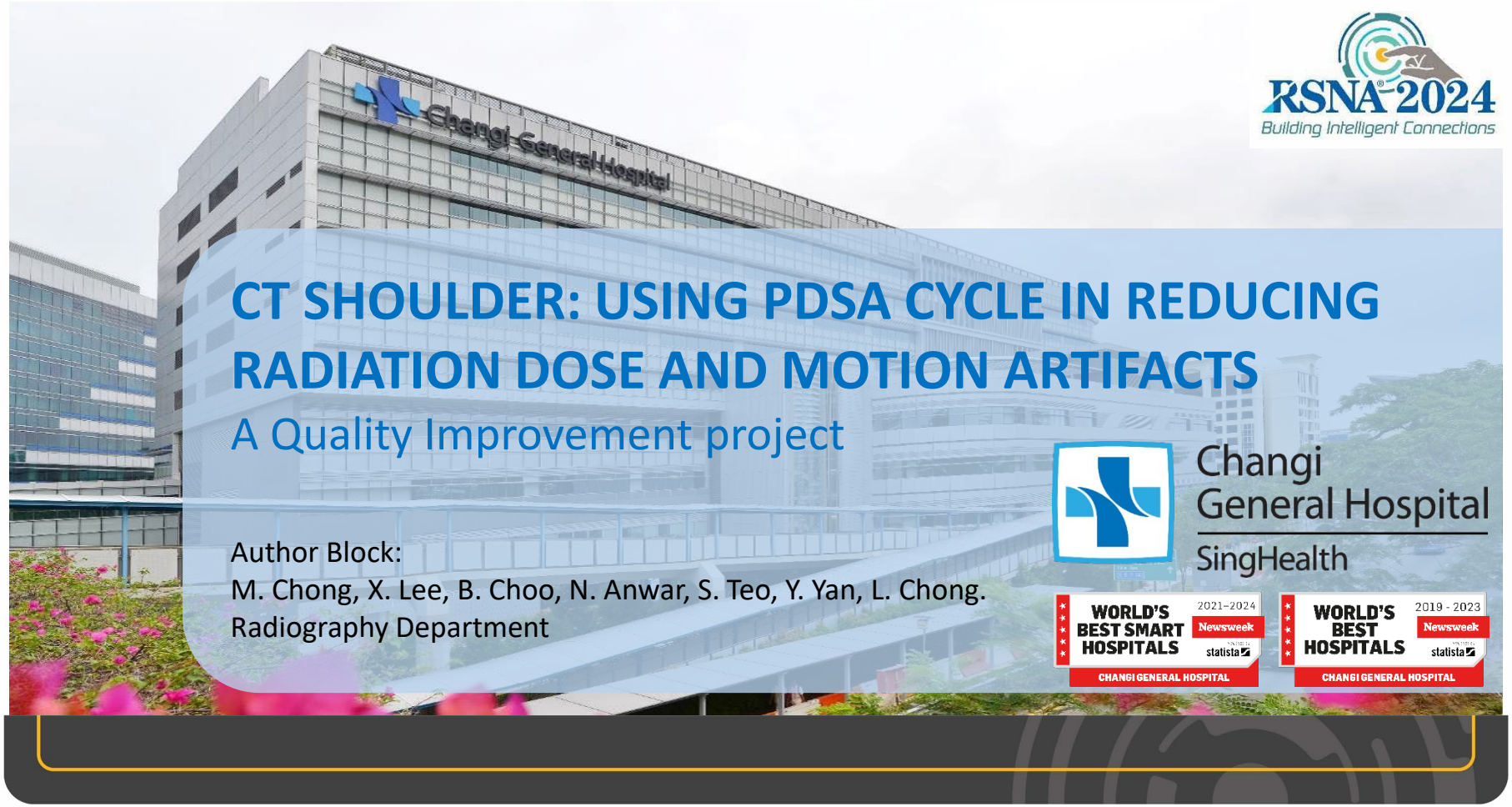

RSNA 2024
Building Intelligent Connections

CT SHOULDER: USING PDSA CYCLE IN REDUCING RADIATION DOSE AND MOTION ARTIFACTS

A Quality Improvement project

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Importance of CT in Shoulder Imaging

Detailed Anatomical Visualization

- CT provides high-resolution images that allow for thorough evaluation of complex shoulder anatomy.
- Critical for identifying fractures, tears, and degenerative conditions.

Preoperative Planning

- Enables surgeons to visualize anatomical variations and plan procedures effectively, enhancing surgical outcomes.

Challenges with Current Practices:

1. Use of Helical Scan Mode:

- Motion artifact (particularly due to breathing) is common.
  This causes the diagnostic value of the images to be reduced.

2. Use of Fixed Tube Current (mA):

- This approach applies a constant radiation dose regardless of patient size or anatomy.
  This leads to higher radiation doses without a proportional benefit.

Overall Impact:

- The combination of higher radiation doses and motion artifacts raises concerns about patient safety and diagnostic efficacy.
- There is a crucial need to optimize scanning techniques to minimize radiation exposure while ensuring good diagnostic image quality.

Objective

- ✓ To modify current CT shoulder scanning techniques to be motion artefacts free and lower radiation.

Aims

- ✓ To reduce the rate of suboptimal images caused by motion artefacts from breathing
- ✓ To lower the radiation effective dose by 40% to patient while maintaining image quality

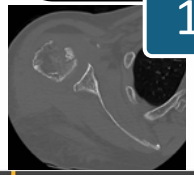
Methodology

- A process of 4 Plan-Do-Study-Act(PDSA) cycles were carried out in a radiology department in a tertiary hospital from January 2020 – December 2023.

- **Measures:**
  - **Radiation dose indicators:**
    DLP (Dose Length Product) – scan length
    CTDIvol (CT Dose Index Volume)
    ED (Effective dose in mSv)

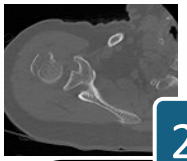
  - **Image quality Evaluation:**
    Qualitative (Subjective) – accessed by 2 radiologists on 5 criteria
    Quantitative (Objective) – measurements on SNR of bony cortex and marrow

Solution Development: 4 PDSA cycles



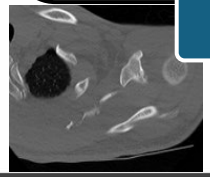
1st PDSA

- Performed **with Helical scan** with fixed mA and **breathing instructions.**
- Motion artefacts reduced however radiation dose remained unchanged.



2nd PDSA

- **Volume Scan Mode** with **fixed mA** was explored.
- With a short scan time of 0.75s, motion artefacts were minimal without breathing instructions.
- Dose reduction target of 40% was not met



3rd PDSA

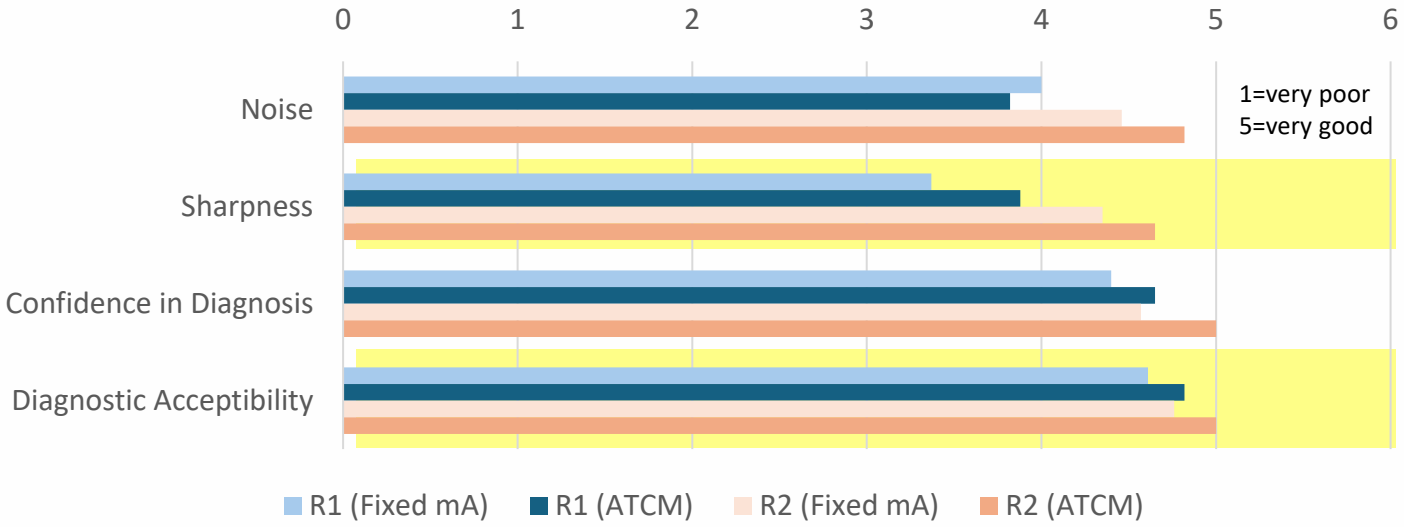
- **Helical scan mode** with **Automatic tube current modulation (ATCM)** was practised.
- Radiation dose efficiency was improved.
- Motion artefacts were not mitigated

4th PDSA

- **ATCM** was combined with **volume scan mode.**
- Radiation dose was significantly reduced while maintaining image quality.

Results: Qualitative Image Evaluation

Table 1: Imaging Rating of 2 Radiologists on Fixed mA vs ATCM Scanning Techniques



- There was no difference between ATCM and fixed mA in presence of artifact, noise and diagnostic acceptability.
- However, there is a difference for sharpness and confidence in diagnosis at SD of 7.5 which is more ideal.

Results: Quantitative Image Evaluation

		Fixed mA		ATC (SD 7.5)		ATC (SD 9)		p-value
		mean	SD	mean	SD	mean	SD	
R1	Glenoid cortex	-1.46	0.14	-1.40	0.12	-1.50	0.11	0.905
	Glenoid marrow	-0.01	0.07	-0.14	0.10	-0.12	0.08	0.212
R2	Glenoid cortex	-1.52	0.17	-1.50	0.19	-1.53	0.16	0.567
	Glenoid marrow	-0.12	0.07	-0.17	0.14	-0.18	0.21	0.865

Table 2: SNR in HU of bony cortex and marrow for different scanning protocols by R1 & R2

- There was also no significant difference in SNR for inter and intra comparison of fixed and modulated mA.

Results: Radiation Dose

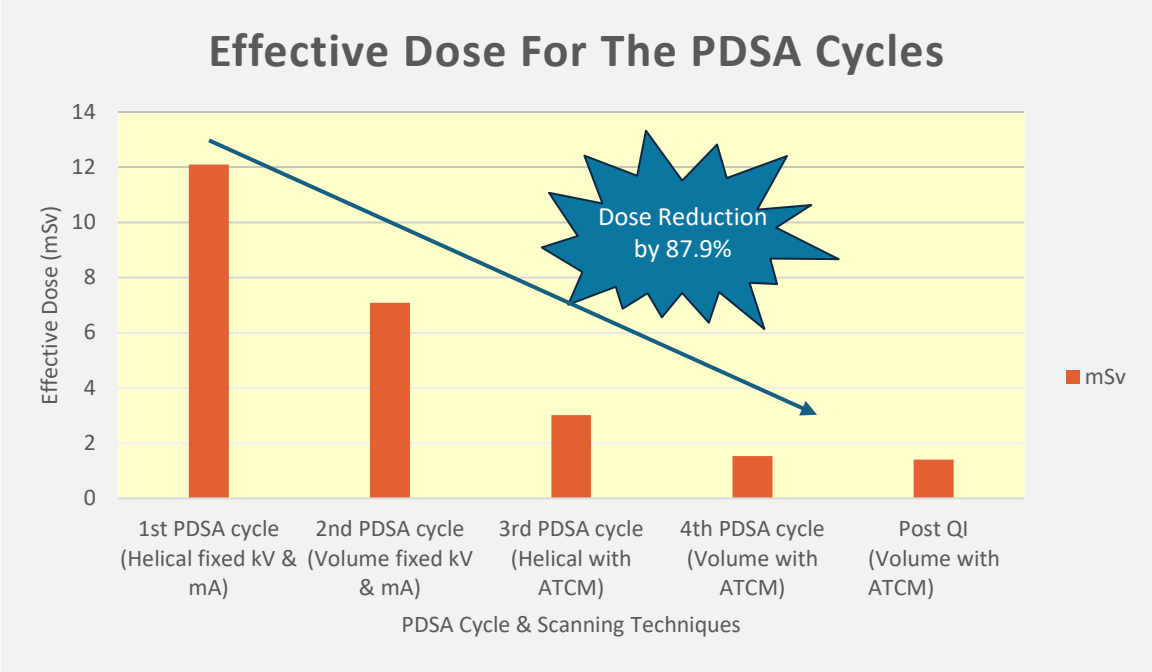


Table 3: Graph Showing the Reduction in Dose

Conclusion

- Volume scan mode with mA modulation has showed to be an effective technique for reducing radiation dose in CT shoulder imaging without compromising the diagnostic quality.

- Higher radiation dose does not necessarily warrant a good quality scan.

- It is important to strike a balance between ALARA principle and preserving diagnostic image quality for an optimized CT protocol.

Thank You

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