Improvement of Depiction of the Intracranial Arteries on Brain CT Angiography Using Deep Learning Image Reconstruction

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Introduction

Materials and methods

Results

Discussions

Conclusions

Purpose

To evaluate the ability of a commercialized **deep learning reconstruction (DLR) technique** (**AiCE**) to depict intracranial vessels on the **brain CTA** and compare the image quality with other reconstruction algorithms (**FBP** and **Hybrid IR**) in terms of objective and subjective measures.

FBP: Filterd-Back Projection
Hybrid IR: Hybrid Iterative Reconstruction

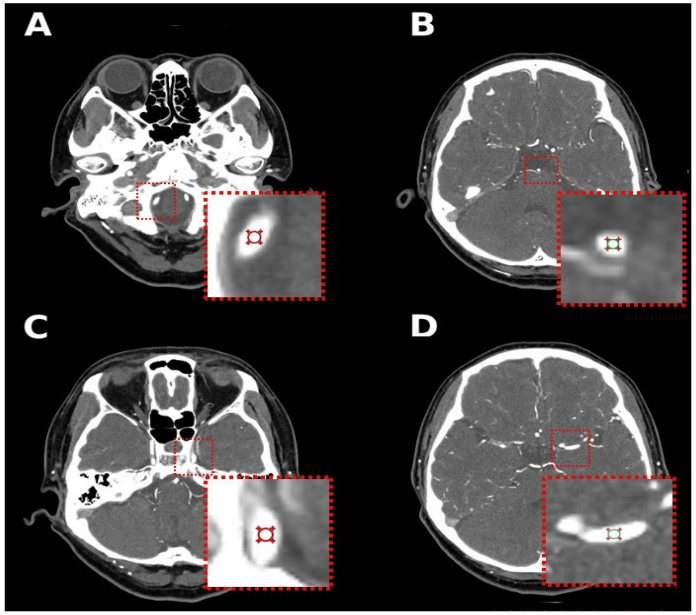
Image analysis

Objective analysis → **Image noise**
SNR
CNR

$$SNR = \frac{Vessel\ (HU\ attenuation)}{Image\ noise}$$

$$CNR = \frac{Vessel\ (HU\ attenuation) - Ref\ (HU\ attenuation)}{Image\ noise}$$

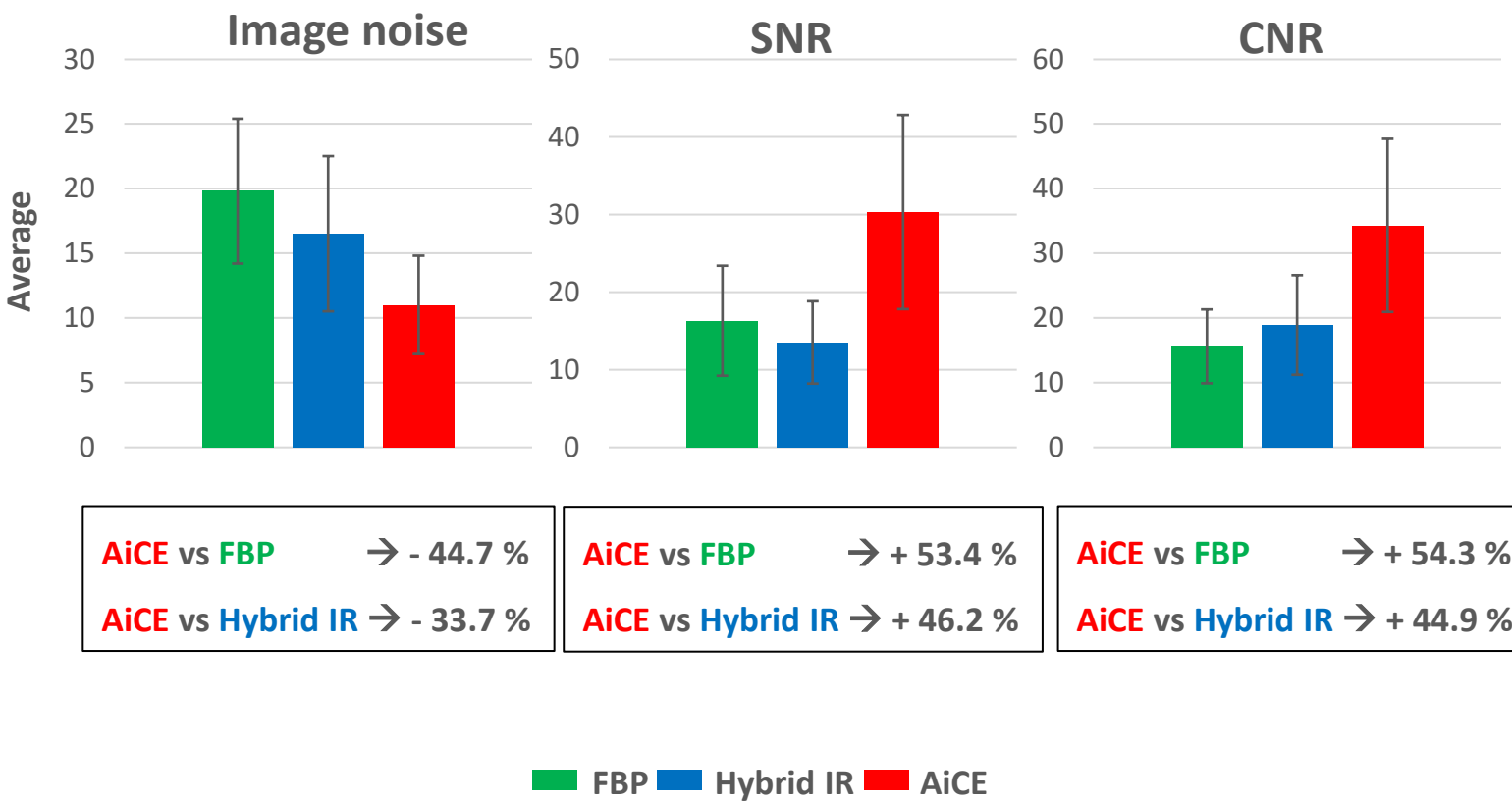
Subjective analysis → **A five point Likert scale**
- Overall image quality
- Vessel delineation wall
- Image noise



Ōtawara, Japan)
- Tube voltage of 120 kVp
- Tube current of 150 mAs
- 0.5 second gantry rotation time
- 0.5 mm slice thickness.

- Total 43 patients
  - 19 were male (44.2%)
  - 24 were female (55.8%)
- Mean age was 56.77 ± 16.31 ranging from 15–88 years.
- The indications for follow-up brain CTAs were as follows:
  - intracranial aneurysm (n=8)
  - vessel dissection (n=2)
  - trauma (n=1)
  - hemorrhage (n=6)
  - acute ischemic stroke (n=2)
  - follow-up study of old infarct (n=5)

Objective analysis: Summary



Subjective analysis

	FBP	Hybrid IR	DLR	P value			
				FBP vs Hybrid IR vs DLR	FBP vs Hybrid IR	FBP vs DLR	Hybrid IR vs DLR
Observer 1							
Overall image quality	2.14±0.35	3.26±0.44	3.46±0.51	0.001	0.001	0.001	0.02
Observer 2							
Overall image quality	2.23±0.43	3.30±0.46	3.49±0.50	0.001	0.001	0.001	0.074

Cohen kappa κ coefficient = 0.77

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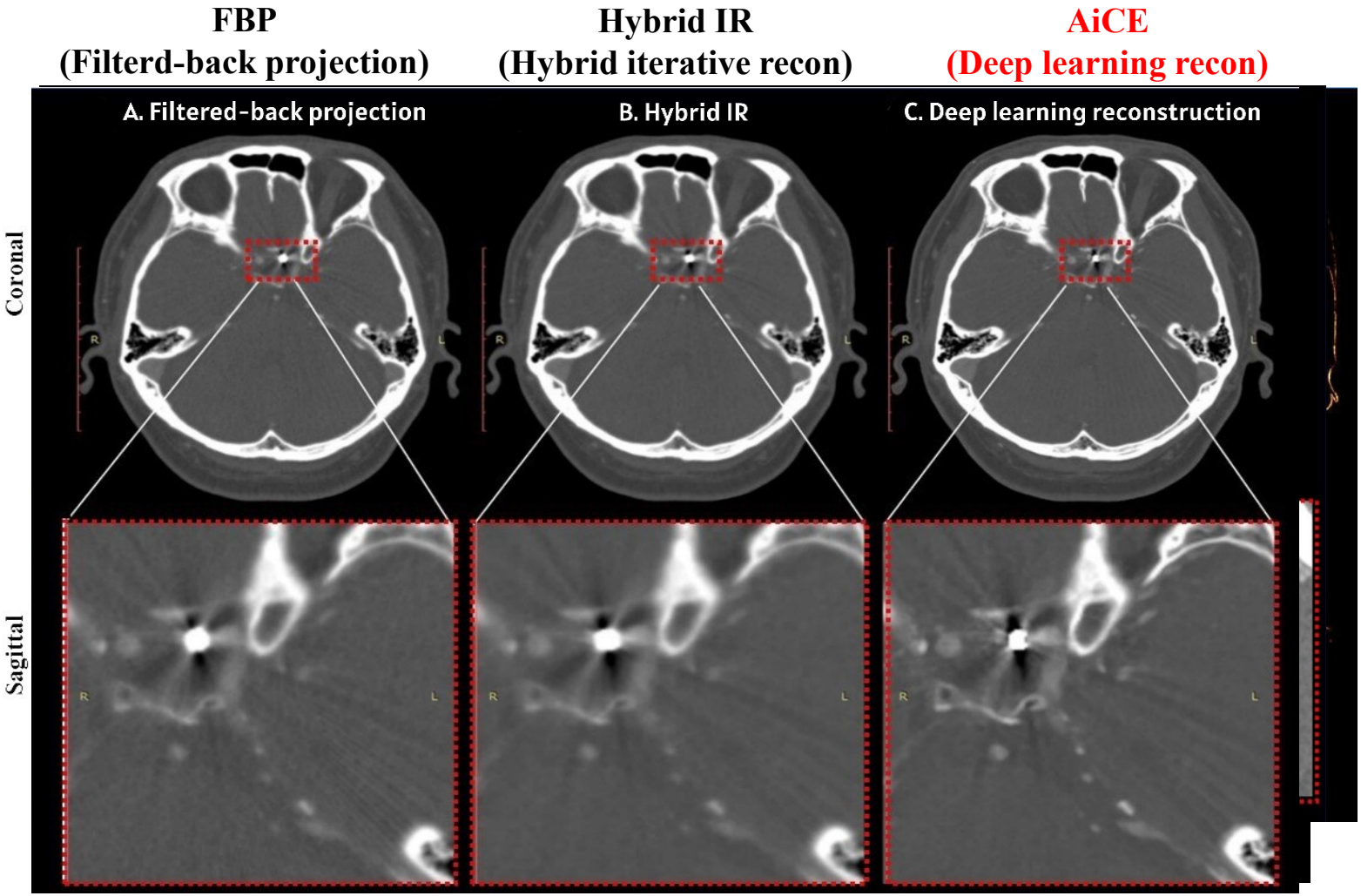

- **Reduction of blooming artifacts** with DLR improved the visualization of intracranial vessels in the regions containing a **surgical clip or coil**.

- DLR is beneficial for **delineating major terminal branches**, e.g., frontobasal and frontopolar arteries, and estimation of the grade of carotid artery stenosis accurately.

- Beneficial for **detecting vascular abnormalities**, including arteriovenous fistula, abnormalities of the collateral vessels, and distal aneurysms.

[3]*Diagnostics (Basel). 2020;10:558.*
[4]*Neuroradiology. 2021;63:905-912*
[5]*Korean J Radiol. 2021;22:131-138.*

Conclusion

- DLR generally improves image quality of brain CTA when compared with FBP and Hybrid IR methods.

- DLR is advantageous for better depiction of small vessels in comparison with FBP and Hybrid IR.