Investigation of buffer thickness for reducing artifacts from the table in CT examinations with extremities 3D imaging

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COI Disclosure

Name of Lead Presenter: Y. Kamihoriuchi
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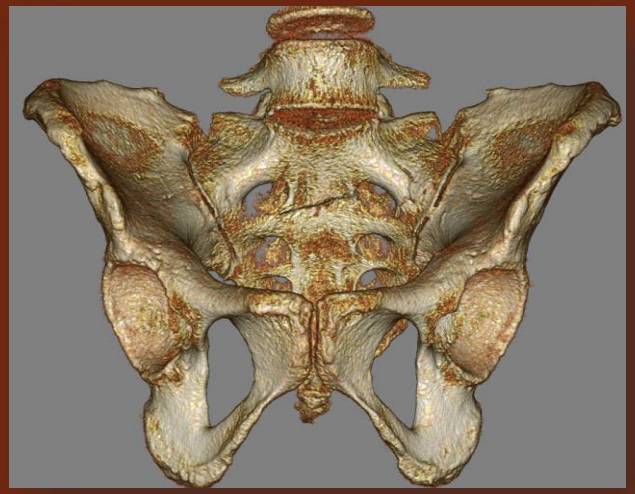
The Lead Presenter has completed COI disclosure to the Radiological Society of North America.

There are no entities or relationships, etc. presenting a potential conflict of interest requiring disclosure in relation to this presentation.

Introduction 1

Computed tomography (CT) volume data can be utilized to effortlessly generate multi-planar reconstruction(MPR) and volume rendering (VR) images, which serve as beneficial resources for treatment selection and surgical support.



Introduction 2

In trauma examinations, the creation of three dimensional (3D) images can be a valuable tool for confirming the presence, size, and depth of foreign bodies and bones.

Introduction 3

It is well-established that during the creation of 3D hand bones through direct placement of fingers on a mat, bed mat artifacts are generated, thereby increasing the overall creation time.

Purpose

The purpose of this study is to investigate the optimal thickness of the buffer material using at the 3D creation, in order to mitigate any artifact generation resulting from the separation of the hand from the CT table mat.

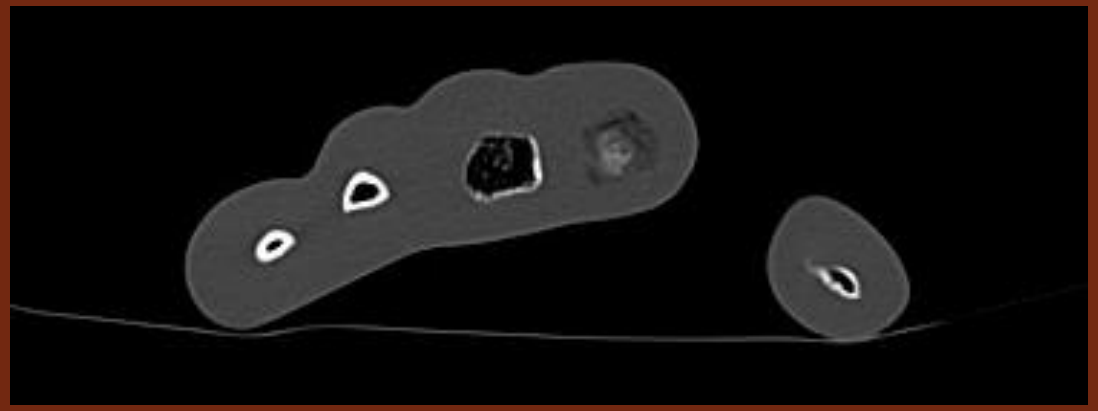
Materials

- CT System：Aquilion Prime SP/iEdition (Canon Medical Systems)
- Phantom：Forearm Human Body Phantom (Kyoto Kagaku)
- Buffer：Styrofoam 1, 2, 3, 4, 5mm,and non-woven gauze for medical used
- 3D Workstation：Ziostation2 Plus ver. 2.9.8.4




Method 1: Scan parameter

- Tube voltage : 135 kVp
- Tube current : 100 mA
- Rotation time : 1.0 s
- Helical pitch : 0.637
- Slice thickness : 1.0 mm
- Field of view : 150 mm
- Reconstruction interval : 0.5 mm
- Number of scans : 10



Method 2: Reconstruction

- FC30 AIDR3D mild : FC30

  For Commonly used bone functions.

Iterative Recon.

- Aice Bone mild , Post-processing Filter(+) : BM

  For Bone function used for bone observation in our hospital

- Aice Bone standard , Post-processing Filter(+) : BS

  For Bone function used for 3D in our hospital

Deep Learning Recon.

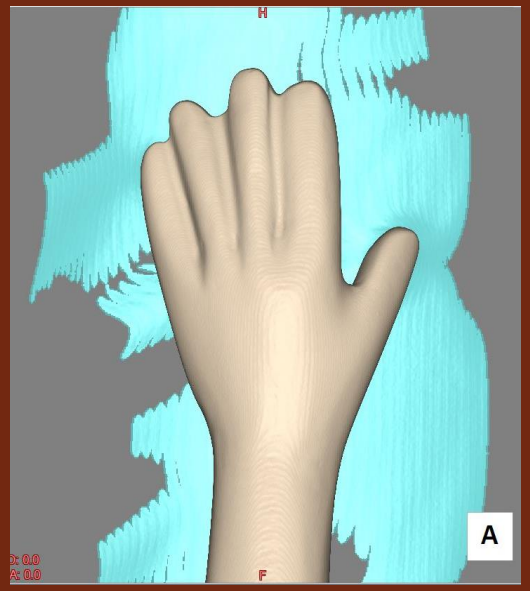
Method 3 : Positioning

- Placement of the phantom in the center of CT gantry
- The phantom's thumb and little finger were positioned on the CT table mat

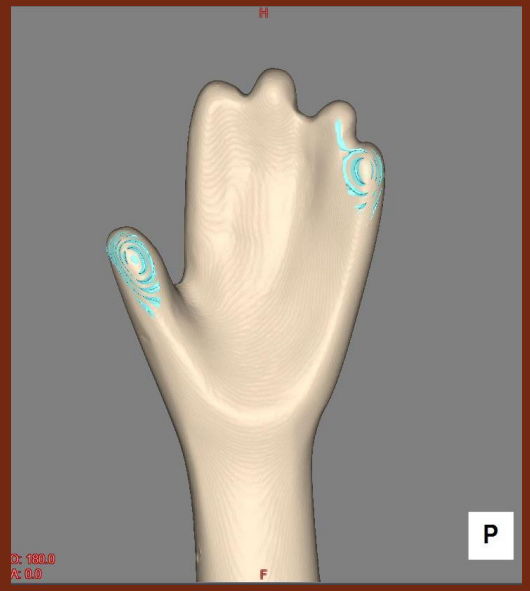
- No buffer （None）
- 1 piece of gauze （Gauze）
- Styrofoam 1, 2, 3, 4, and 5 mm

Method 4: Visual evaluation

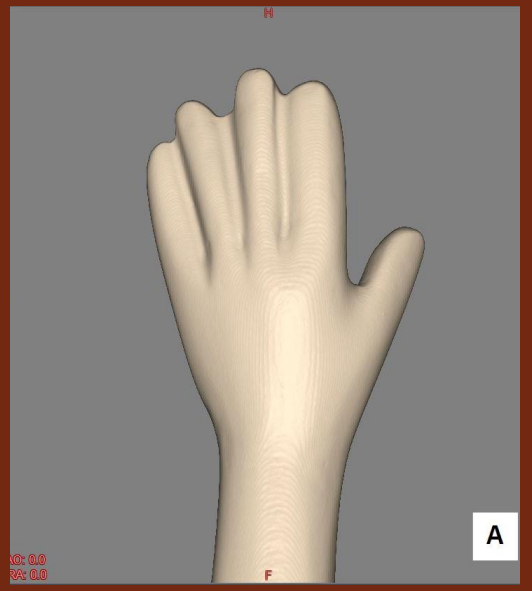
- A radiology technologist with 7 and 9 years of experience qualitatively evaluated in this study.
- Artifacts were evaluated using a 3-point scale at the 0 or 100 threshold.



0 : Poor



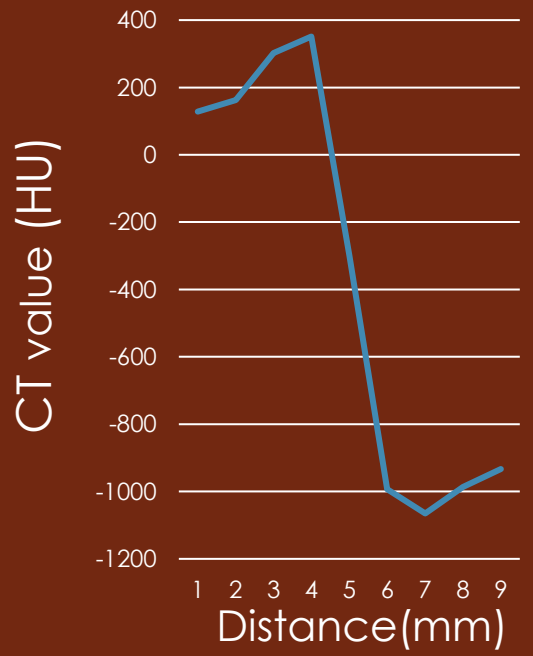
1 : Good

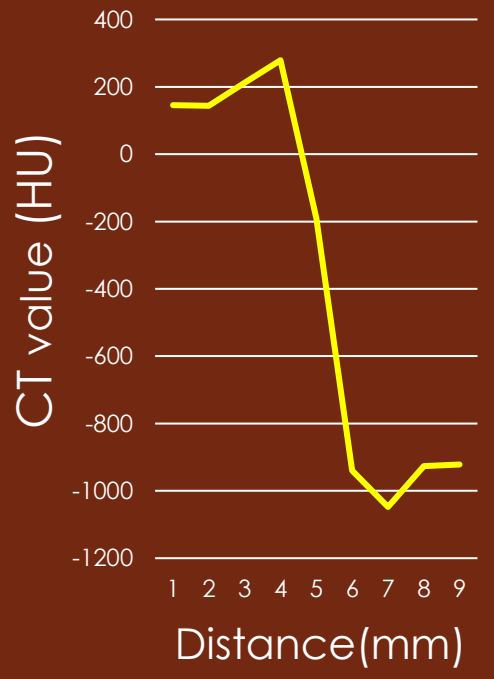


2 : Excellent

Method 5: Maximum CT values

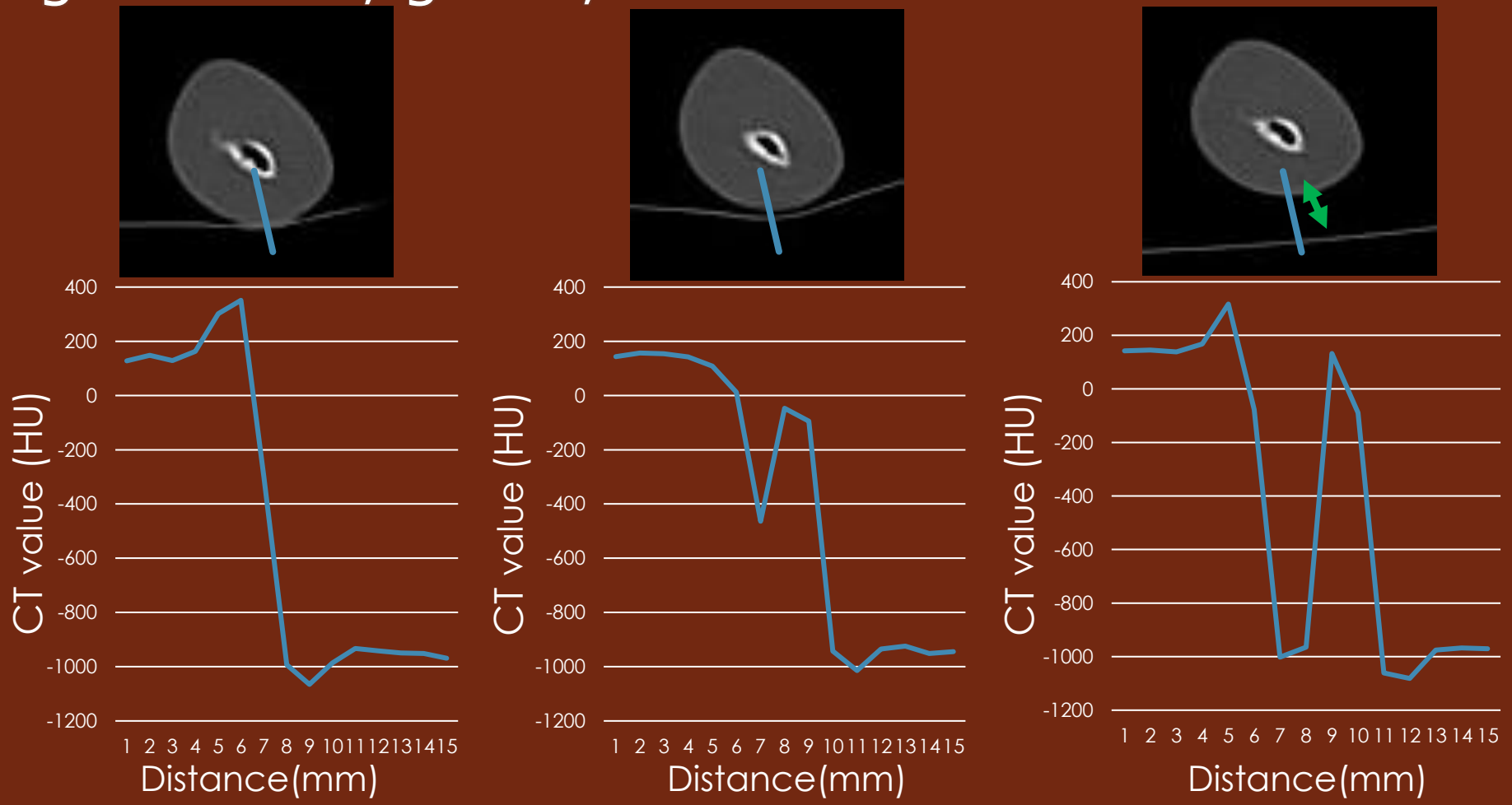
- Place three region of interest (ROIs) on the same slice of both the unbuffered and 5mm buffered images
- Created profile curves
- Compared for the maximum CT values of phantom edge





Method 6: FWHM of gap

- Compared for the full width at half maximum (FWHM) among no buffer, gauze, buffer 1mm



Method 7: Statistical analysis

- EZR Ver.1.55

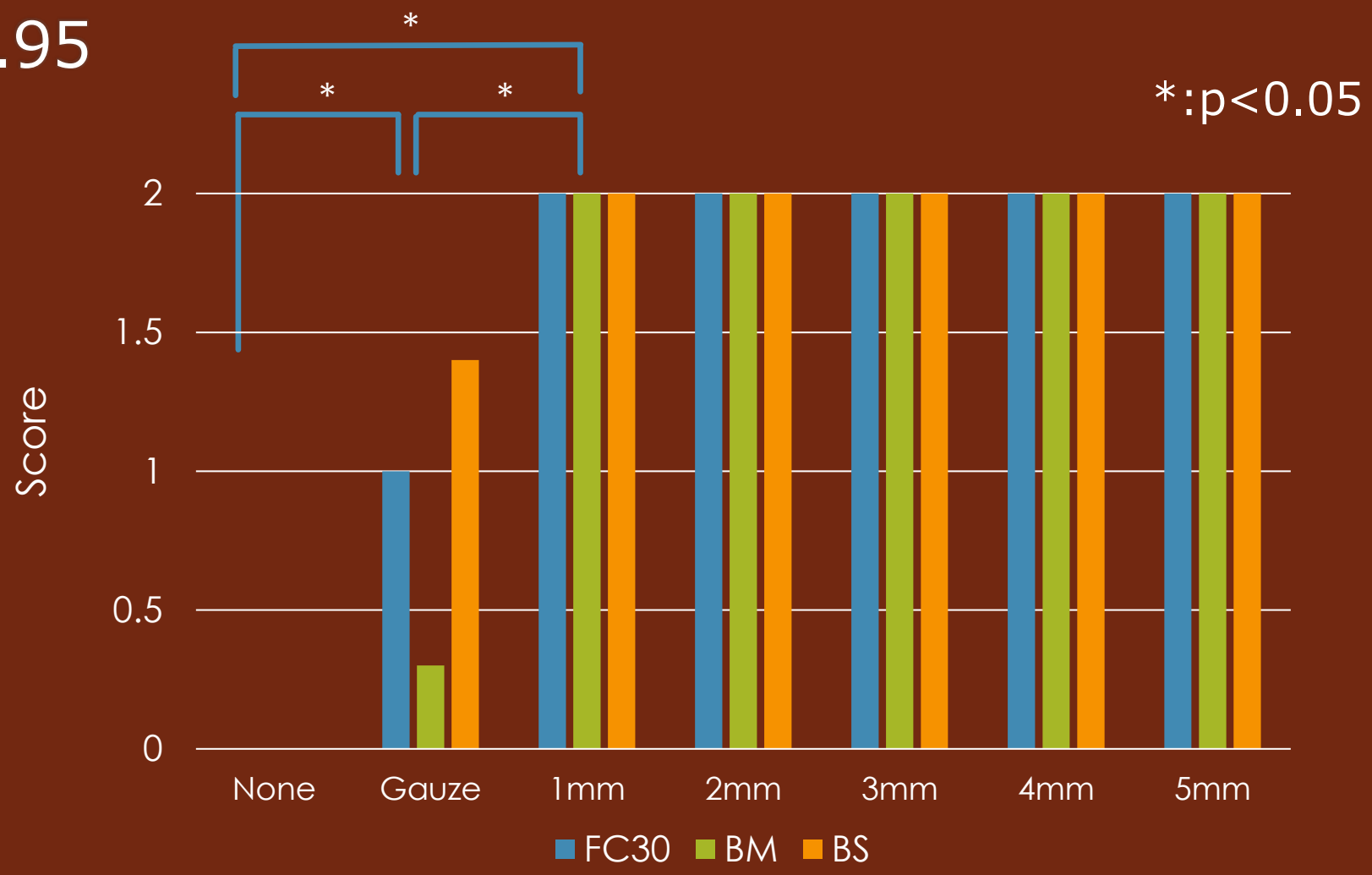
  Kruskal-Wallis test or Mann–Whitney U test

  Differences were considered statistically significant at $p < 0.05$
- Cohen's kappa coefficient

Results 1: Visualization score

Threshold : 0

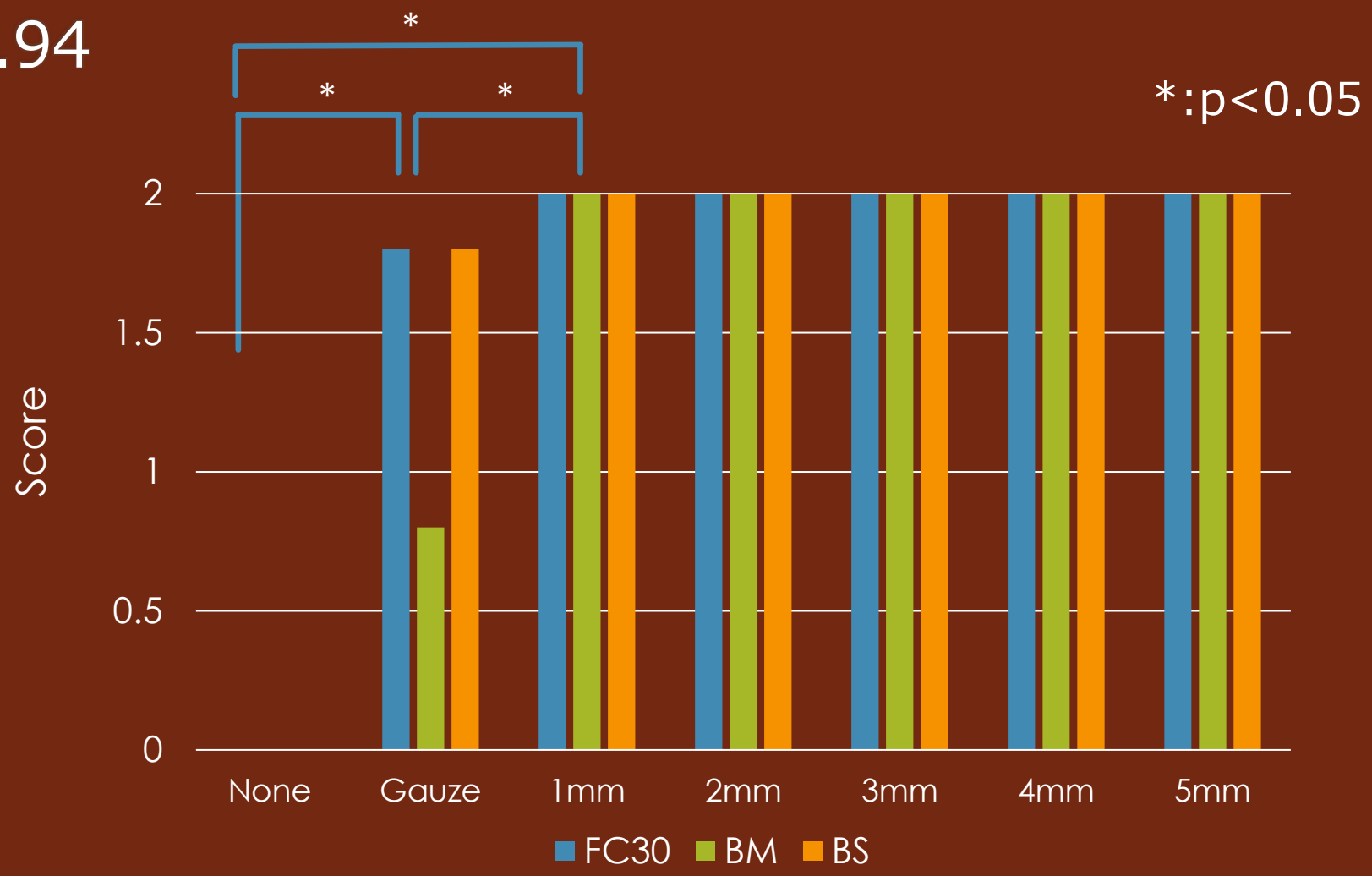
k = 0.95



Results 2: Visualization score

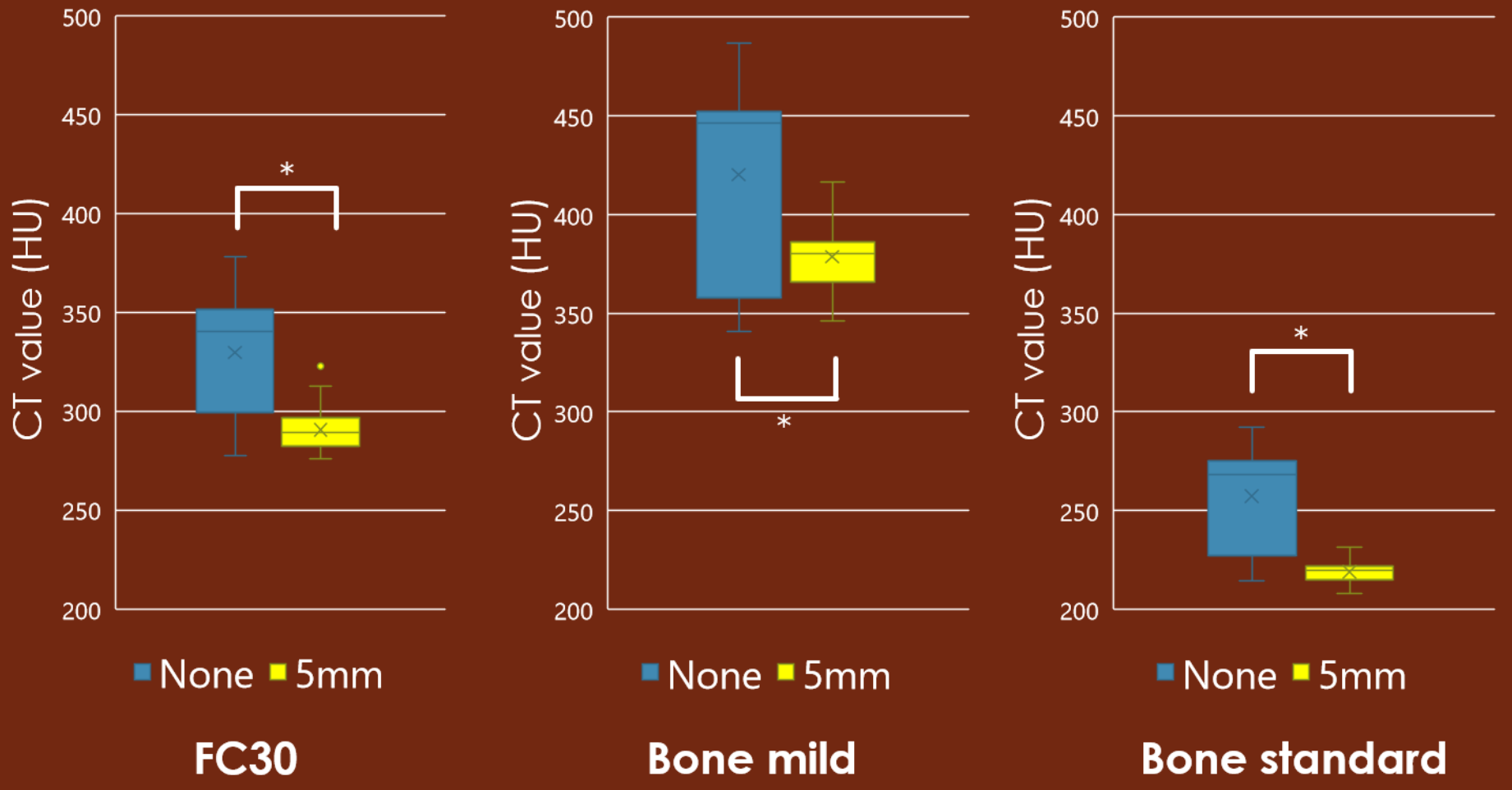
Threshold : 100

k = 0.94



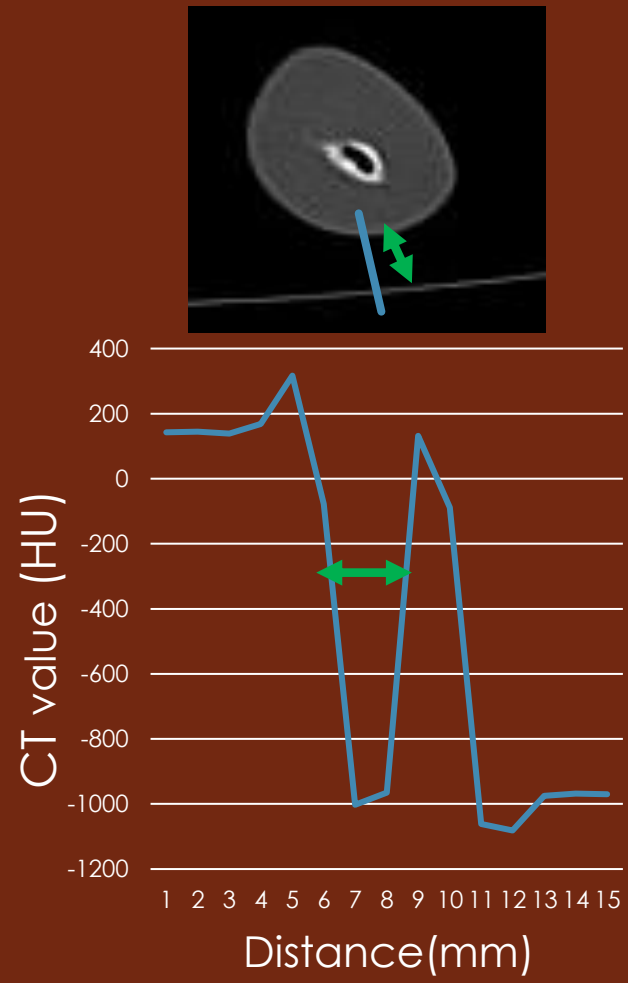
Results 3: Maximum CT values

*:p<0.05



Results 4: FWHM of gap

	Gauze	1mm	p value
FC30	0.77(0.71-0.85)	1.08(1.07-1.18)	< 0.05
Bone mild	0.72(0.63-0.81)	1.00(0.99-1.08)	< 0.05
Bone standard	0.70(0.41-0.82)	1.10(1.04-1.16)	< 0.05



None : No gaps were detected by the method of this study.

Summary

- The maximum CT value of the phantom edge was significantly higher at None than at 5 mm in all conditions.
- A comparison of the FWHM of the gap indicated that the gauze was significantly narrower than the Styrofoam.
- Additionally, visual evaluation revealed that the gauze was not consistently effective in providing separation.
- It was confirmed that using a buffer material of 1 mm or more can significantly reduce the effects of artifacts from the CT table mat, which can improve the quality of 3D imaging of the hand and increase flexibility in positioning.

Conclusion

By inserting a buffer material with a thickness of at least 1mm between the hand and the CT table mat at creating 3D imaging, the separation of the hand and the CT table mat can be achieved easier for regardless of the conditions.

Thank You

- If you have any further questions or comments, please don't hesitate to contact me by e-mail

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