

Visual Evaluation of Scatter Correction Using Clinical Images

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Disclosure of conflict of interest

We have nothing to declare for this study.

Background

A software-based scatter correction (SC) method has been developed that is designed to restore image contrast of non-grid images in a manner comparable with an anti-scatter grid.

Grid(+), 90kV, 0.8mAS

Grid(-), 90kV, 0.4mAs, SC(-)

Grid(-), 90kV, 0.4mAs, SC(+)



Background

Several works evaluate the physical characteristics of SC **with phantom study.**

ECR 2015, DOI: 10.1594/ecr2015/C-1834

ECR 2016, DOI: 10.1594/ecr2016/C-0416

SC offers an **alternative to the usage of an grid** for **bedside chest radiography** in terms of contrast improvement.

Radiat. Prot. Dosim. 2016, 169: 308-312

Even though image quality of SC chest X-ray does not fully reach the level of grid(+) images, SC have potential of the **significant reduction of ~50 % in patient dose.**

Radiat. Prot. Dosim. 2016, 169: 60-67

Purpose

To investigate the utility of scatter correction applied to **clinical images** especially **infant chest** and **adult knee joint** using **visual evaluation**

Materials

X-ray systems

RADspeed Pro (SHIMADZU)

X'sy Pro (SHIMADZU)

Flat panel detector

CXDI-701C, 801C Wireless (CANON)

Image processing software

CXDI Control Software NE Ver. 2.15 (CANON)

Monitor

RadiForce GS521 (EIZO)

Image acquisition | Infant chest

Patients

30 infants (mean: 2.3 yo, range: 0-5 yo)

X-ray exposure parameters

kVp	55 - 65
mA	250
mAs	1.25 - 3.50
SID (cm)	120 - 200

Scatter correction factor

without and '1' (max= 10)

Image acquisition | Adult knee joint

Patients

30 (Right: 14, Left: 16)

X-ray exposure parameters

kVp	55 - 58
mA	125
mAs	4.0 - 5.0
SID (cm)	120

Scatter correction factor

without and '1' (max= 10)

Visual Evaluation

Six radiological technologists subjectively assessed the image quality with SC compared to w/o SC as following grades.

- 2 Bad
- 1 Somewhat bad
- 0 Equivalent
- 1 Slightly good
- 2 Good

Wilcoxon signed rank sum test was performed.

P value <0.05 was considered statistically significant.

Visual Evaluation | Infant chest

- Mediastinal lines
- Both pulmonary artery markings and bronchus shadow of the hilar region
- Pulmonary markings of retrocardiac area
- Graininess
- Sharpness
- Contrast
- “Impressive” overall image quality

Visual Evaluation | Adult knee joint

- Sharpness of trabeculae
- Graininess of soft tissue
- Margin of patella
- Contrast
- “Impressive” overall image quality

E.g. | Retrocardiac

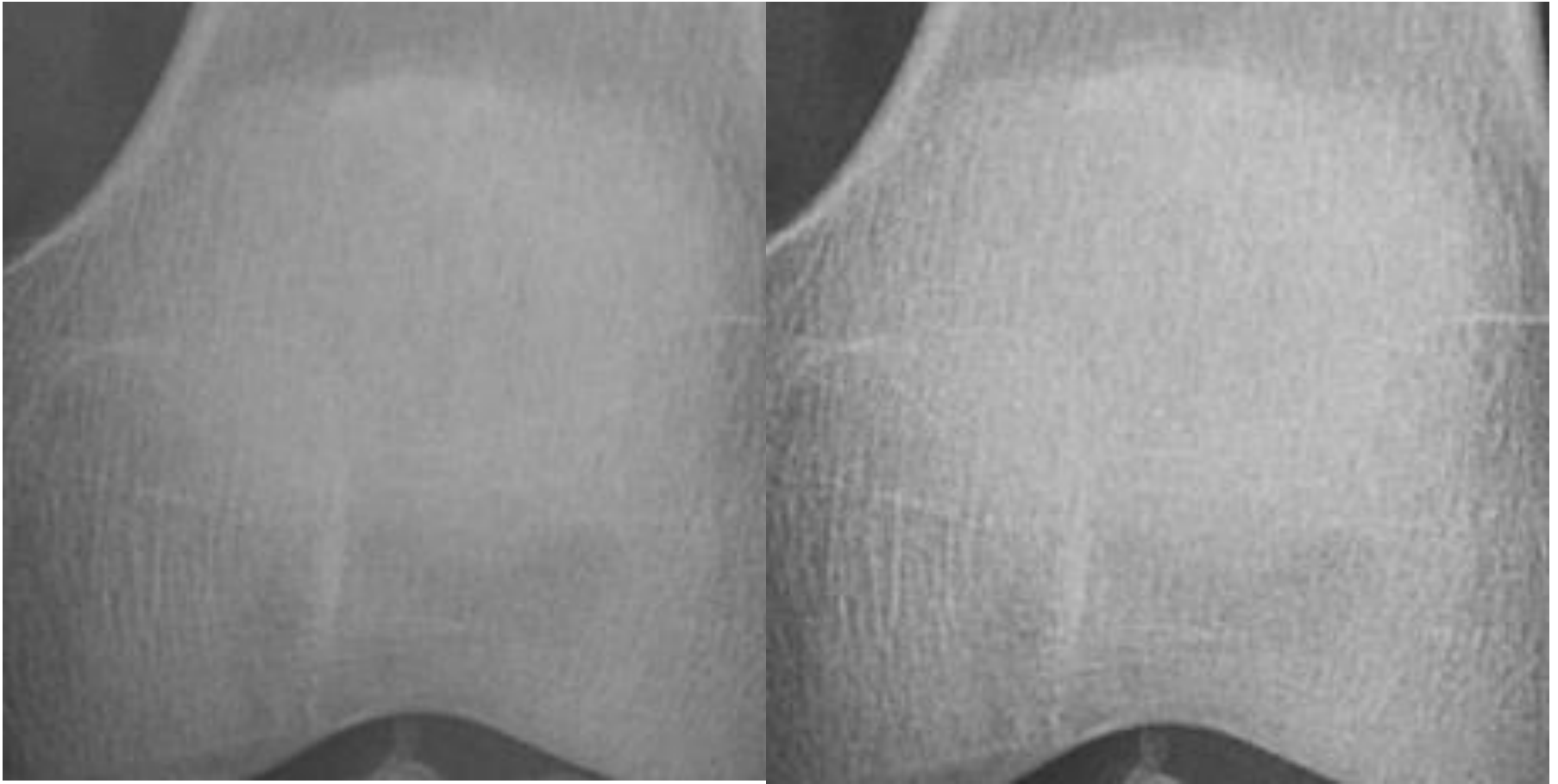


Without SC



With SC

E.g. | Margin of patella



Without SC

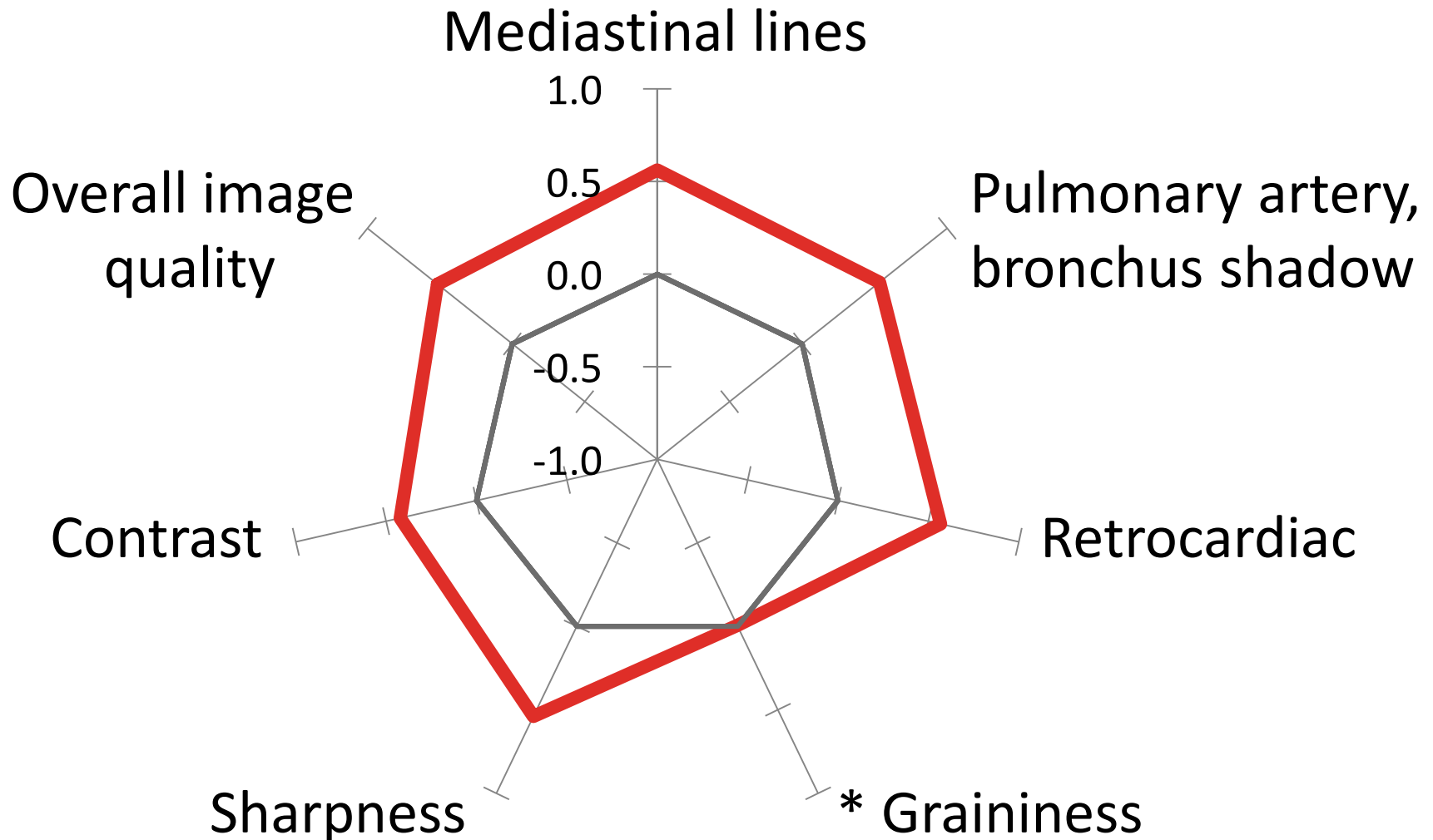
With SC

Results | Infant chest

Object	Mean (95% CI)	SD	Max	Min
Mediastinal lines	0.56 (0.49–0.63)	0.50	1.00	0.00
Pulmonary artery, bronchus shadow	0.53 (0.46–0.61)	0.52	1.00	-1.00
Retrocardiac	0.57 (0.49–0.64)	0.50	1.00	0.00
Graininess	-0.01 (-0.08–0.06)	0.48	1.00	-1.00
Sharpness	0.54 (0.46–0.61)	0.51	1.00	-1.00
Contrast	0.42 (0.33–0.52)	0.64	2.00	-1.00
Overall image quality	0.52 (0.42–0.61)	0.64	2.00	-1.00

CI = confidence interval; SD = standard deviation

Results | Infant chest



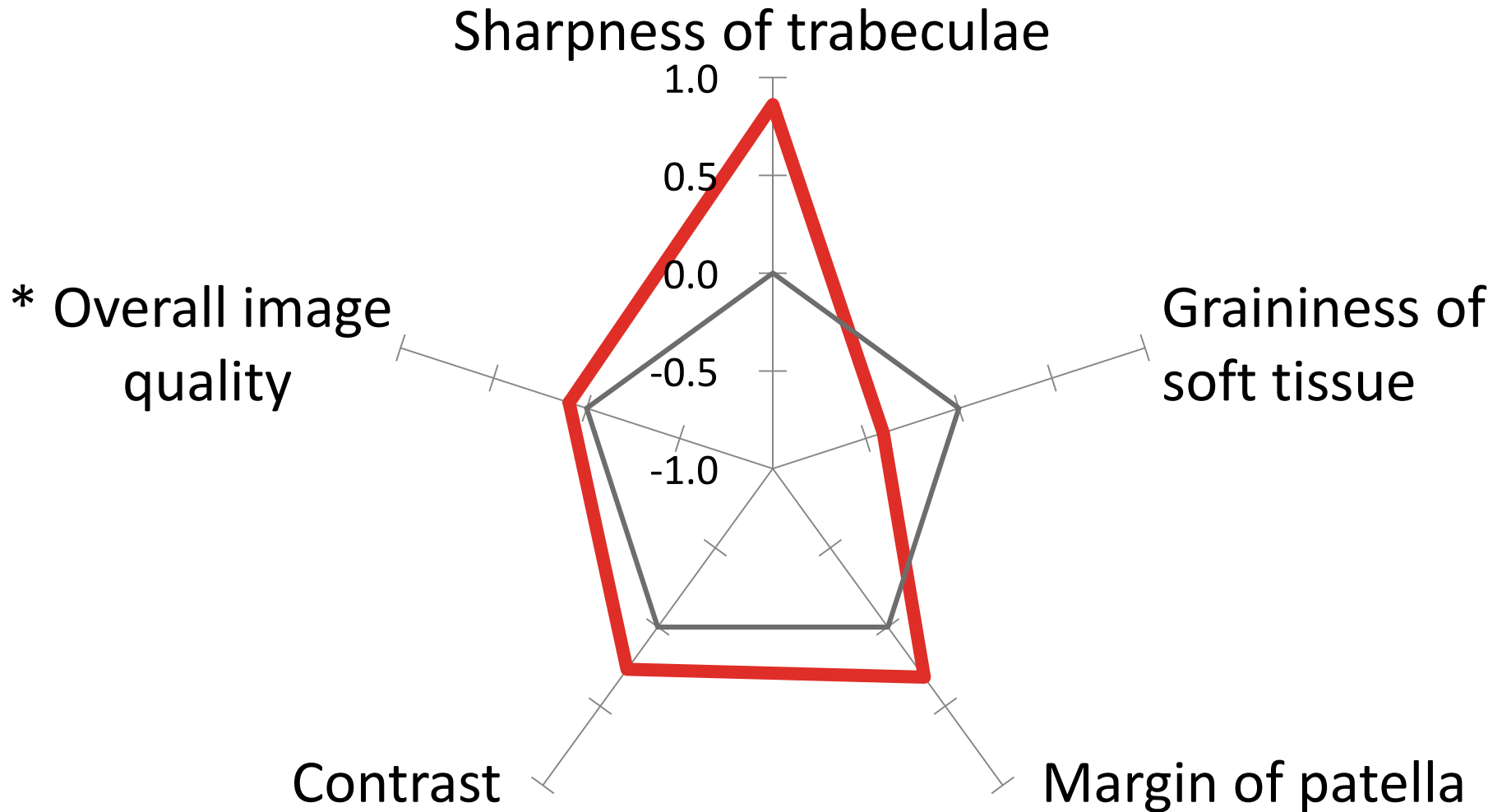
* : N.S.

Results | Adult knee joint

Object	Mean (95% CI)	SD	Max	Min
Sharpness of trabeculae	0.86 (0.79–0.93)	0.48	2.00	-1.00
Graininess of soft tissue	-0.41 (-0.50–-0.31)	0.67	1.00	-2.00
Margin of patella	0.32 (0.23–0.41)	0.60	2.00	-1.00
Contrast	0.27 (0.14–0.39)	0.84	2.00	-2.00
Overall image quality	0.11 (-0.22–0.23)	0.86	2.00	-2.00

CI = confidence interval; SD = standard deviation

Results | Adult knee joint



* : N.S.

Discussion

SC improved image quality even with dose for non-grid X-ray.

- Increased dose is no need.
- SC may be applied to other subject.
(e.g. infant abdomen and chest-abdomen)
- Image quality improvement is limited because of only applying SC without dose adjustment.

Discussion

Degradation of graininess

- SC led to contrast enhancement, but noise component was not removed.
- Simultaneous use of noise reduction processing is required.
- Balance between SC image quality and noise level should be considered.

Conclusions

- Scatter correction with same dose for non-grid X-rays can improve image quality of infant chest and adult knee joint X-rays.
- Scatter correction is clinically useful.