Gemstone Spectral Imaging improves soft tissue visualization and reduces beam-hardening artifacts

CT clinical case study – spinal hardware

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Abstract
Image quality, as it relates to computed tomography (CT), is subject to several quality-altering variables. A major obstacle to overcome is the interference of metal for those patients with surgically inserted screws or prosthetics. When metal is near—or part of—the area of interest, diagnosis and treatment can be challenging due to artifacts that can distort an image. So that optimum clarity can be achieved, those artifacts need to be minimized.

By dialing in the optimum spectral energy, the Discovery* CT750 HD helps doctors and technologists to see the anatomy virtually artifact-free including soft-tissue structures that are often obscured. Enabled by beam-hardening suppression of GSI—a projection-based dual energy reconstruction—it’s a development that leads to more confident diagnoses.

Patient histories
Three patients—one cervical, one thoracic, and one lumbar spine—with spinal hardware for follow-up CT scans.

Protocol
GSI acquisition
Monochromatic images

Acquisition protocols
Scanner: Discovery CT750 HD
Scan type: GSI-Helical
GSI preset: C-Spine: GSI 11
T-Spine: GSI 12
L-Spine: GSI 10
Rotation speed: 0.5 seconds
Detector configuration: 64 x 0.625
Slice thickness: 0.625 mm
Pitch: 0.98:1
SFOV: 50 cm
kVp: Low/High (80/140 kVp)

Clear, easy-to-understand images are critical in improving diagnoses and patient health.
Discussion and results

The 70 keV images represent a typical ~120 kVp attenuation with the associated beam-hardening artifacts. These artifacts have a significant impact on clarity and accuracy. By comparison, the 90 keV in the C-Spine image, 100 keV in the T-Spine image, and the 105 keV in the C-Spine image demonstrate how beam-hardening can be reduced. In turn, these images with reduced artifacts allow for better anatomy visualization including soft-tissue structures that were previously obscured, such as the spinal cord and soft tissue surrounding metal hardware.

Conclusion

Spectral Imaging allows the user to tune the energy of the Monochromatic Images to reduce beam-hardening artifacts associated with metal hardware. In the cases above the 70 keV images represent typical ~120 kVp attenuation and beam-hardening artifacts and the 90 keV in the C-Spine, 100 keV in the T-Spine, and the 105 keV in the L-Spine are examples demonstrating how beam-hardening is reduced allowing for better visualization of the soft tissue structures that were previously obscured, e.g. Spinal canal and soft tissue surrounding metal hardware. We now routinely image the instrumented spine at the optimal 110 keV and see a significant increase in image quality.**

**Reference:
J Kessler, MD, MPH; J C Rios, MD, PhD; M Ellestad; P Pawha, MD; A Doshi, MD; E G Stein, MD, PhD; L N Torenbaum, MD, FACR. Dual Energy Spectral CT (DESCCT) Allows Selection of the Optimal Monochromatic Energy for Imaging the Instrumented Spine and Improves Diagnostic Quality over Traditional Imaging. Presented at RSNA Annual Meeting Chicago, IL November 2010.
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Figure 1. Axial 70 keV C-Spine

Figure 2. Axial 90 keV C-Spine

Figure 3. Sagittal 70 keV C-Spine

Figure 4. Sagittal 90 keV C-Spine
The Discovery CT750 HD makes significant progress in imagery of anatomy affected by metal artifacts.

Figure 5. Axial 70 keV T-Spine

Figure 6. Axial 100 keV T-Spine
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Figure 7. Sagittal 70 keV T-Spine

Figure 8. Sagittal 100 keV T-Spine
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