Purpose: X-ray scatter has been identified as a principal factor in cone-beam CT (CBCT) image quality in applications ranging from dental to IGRT and image-guided surgery. The variety of system geometries entail disparate scatter magnitudes, which bear heavily on the question of utility of antiscatter grids. This paper revisits this question for low-dose CBCT on a mobile C-arm for image-guided surgery, identifying tradeoffs in dose and image quality and answering the question of when (or whether) grids should be employed.

Methods: Studies were performed on a mobile C-arm prototype equipped with a flat-panel detector for high-quality CBCT. Antiscatter grids of grid ratio (GR) 6:1 – 12:1 (103 lpi) were tested under varying scatter conditions in "body" surgery (e.g., spine) using task-specific protocols for bone and soft tissue visibility in the thorax and abdomen. Studies included grid orientation, CT number accuracy, uniformity, contrast, noise, and contrast-to-noise ratio (CNR), each evaluated in quantitative / anthropomorphic phantoms.

Results: Grid orientation along the detector z-axis introduced susceptibility to artifacts attributed to ramp filter amplification of gridlines under motion nonidealities. Orientation along the xy-axis resolved this effect. Increasing GR improved CT number accuracy from 40% error (no grid) to 4% (12:1), but imparted an increase in noise by ~20-60%. CNR for high-contrast objects was largely unaffected by grids, but a significant reduction (2-44%) in CNR was observed in low-contrast soft-tissues.

Conclusion: While grids showed substantial improvement in CT number accuracy and uniformity, soft-tissue CNR was reduced due to grid attenuation in both the thorax and abdomen. The CNR could be restored by increasing the dose by a factor of 1.5. This poses a significant drawback to low-dose, repeat CBCT and diminishes the extent to which grids should be employed, particularly in light of simple scatter correction techniques that offer comparable restoration without increase in dose.

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