Purpose: High-resolution region-of-interest (ROI) imaging requires the use of a small focal spot with sufficient output to maintain spatial and contrast resolution. We investigate methods to increase the x-ray output while maintaining the focal-spot size for a small field-of-view (FOV) as needed for endovascular-image-guided interventions (EIGIs).
Materials and Methods: We evaluated the increase in tube output made possible by reducing the anode angle and lengthening the filament for the small focal spot to maintain a constant effective focal-spot size. Since the area of heat deposition on the anode is increased, tube-loading capacity increases and the mA can be increased proportionally if the electron flux density at the target is unchanged. "Spek Calc" software was used to calculate the change in inherent tube filtration and in x-ray spectrum and intensity as a function of anode angle. The gain in tube output achievable while maintaining focal-spot size was determined for the small-FOV of our custom high-resolution, ROI imager. When the same tube is used for both large-FOV imager and the small-FOV ROI imager, angling the tube and adjusting filament length can allow a tradeoff between spatial resolution, tube loading and FOV.
Results: For the 5-cm FOV needed in neurovascular ROI imaging, the x-ray output could be increased substantially with decreasing anode angle while the focal-spot size and FOV is maintained. Considering both increased anode-target area and increased inherent anode filtration, a net output increase of 3.3 times could be achieved with a 2-degree anode angle compared to the standard 8-degree target with an increase of 4 times in filament length.
Conclusions: For EIGIs where high resolution is essential but only over a small FOV, higher tube output while maintaining a small focal spot should be achievable with only small modification of standard x-ray tube geometry.
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