Purpose:
In current cone-beam CT imaging, one acquires data at hundreds of views, at the cost of a non-negligible amount of radiation dose as well as prolonged scanning time. Enabled by advanced, iterative algorithms, progress has recently been made on image reconstruction from sparse-view data, which can potentially reduce imaging radiation dose and scanning time. For cases where data are highly sparse, such as when only a few (e.g. <10) projections are available, accurate image reconstruction becomes challenging. However, prior knowledge of the imaged subject such as sparse structures may be utilized to improve reconstruction fidelity. In this work, we investigated the incorporation of image sparsity into the framework of novel iterative algorithms for few-view image reconstruction of sparse objects.

Methods:
We incorporated image sparsity by combining the hard-thresholding technique into the framework of the adaptive-steepest-descent-POCS (ASD-POCS) algorithm. We performed simulation studies by using a numerical artery phantom, and real-data studies by using micro-CT data of a human coronary artery specimen. The number of projections under study ranged from 3 to 10. A number of quantitative metrics were used to evaluate the image-reconstruction performance.

Results:
Images of numerical phantoms and the real coronary artery specimen were accurately reconstructed from as few as <5 projections. Quantitative metrics showed that the quality of few-view image reconstruction using the proposed algorithm is comparable to that of image reconstruction using existing algorithms from data acquired at 360 to 720 views.

Conclusions:
We have demonstrated that by incorporating appropriate image-sparsity information into novel iterative algorithms, CBCT images can be reconstructed accurately from a few projections. The proposed technique may potentially be used for in-vivo and in-vitro coronary artery imaging.