Purpose:
Cone-beam CT (CBCT) is widely used for providing image guidance in radiotherapy and interventional procedures. Due to the patient safety concern involved in repetitive CBCT scans, significant effort has been devoted to possibly lowering imaging dose in CBCT. For a given total dose, it is also important to investigate how image quality can be affected by dose allocations over projection views and by image-reconstruction algorithms. In this work, we investigate quantitatively how image quality changes resulted from different combinations of dose-allocation parameters and some existing reconstruction algorithms.

Methods:
We performed simulation studies by using a numerical phantom containing structures of different contrast levels. We also acquired real data of a Catphan phantom (The Phantom Laboratory, Salem, NY) by using the on-board imaging system (Varian Medical Systems, Palo Alto, CA). At three different total dose levels, we allocated each of them to different numbers of views ranging from 120 to 650. For each allocation scheme we applied the FDK and ASD-POCS algorithms to obtain reconstructed images. A set of quantitative metrics were used to evaluate image quality based on relevant tasks.

Results:
Preliminary results showed that for total dose levels under study, both FDK and ASD-POCS algorithms yield images with comparable quality when a large number of views are considered and that images reconstructed by the ASD-POCS from smaller number of views generally exhibit higher quality. Overall, for each given total dose level the ASD-POCS algorithm yields images of comparable or higher quality than does the FDK algorithm.

Conclusions:
We demonstrated that CBCT image quality can be optimized for a fixed total dose by choosing an appropriate combination of dose-allocation parameters and reconstruction algorithm. This finding may potentially be used for improving current CBCT image quality and for designing innovative, low-dose CBCT imaging protocols.