Purpose:
Although volumetric CT (VCT) is widely used nowadays, its imaging performance is greatly hindered by the inferior image quality mainly owing to large x-ray scatter signals, which lead to CT number inaccuracy and image contrast loss. Among existing algorithms, measurement-based scatter correction methods efficiently obtain accurate scatter estimation without prior knowledge on the object. However, with a beam blocker in the field to attenuate primary, it is generally believed that the acquired data in scatter measurement projections are not complete for an accurate reconstruction. Thus an extra scan or moving the blocker during the scan is typically required. In this work, we propose a new measurement-based scatter correction algorithm without primary compensation. An accurate reconstruction is achieved with one single scan and a stationary x-ray beam blocker, two seemingly incompatible features.

Methods:
The blocked areas are distributed over the projection where primary signals are redundant using a new beam blocker with a “crossing finger” shape. Scatter is then accurately estimated by interpolation and scatter-corrected CT images are obtained using an FDK-based reconstruction. Three blockers with different strip gaps are manufactured for optimal strip gap selection.

Results:
The proposed method is evaluated using two phantom studies on our tabletop CBCT system. On the Catphan©600 phantom, our approach reduces the reconstruction error from 207 to 9 Hounsfield unit (HU) in the selected ROI, and improves the image contrast by a factor of 2 in the high-contrast regions. On an anthropomorphic head phantom, the reconstruction error is reduced from 154 to 3 HU in the soft-tissue region. A blocker with a strip gap of 20mm achieves optimal image quality.

Conclusions:
Our method inherits the main advantages of measurement-based methods while avoiding their shortcomings. It has the potential to become a practical scatter correction solution widely implementable on different VCT systems.