Purpose: To search for a fiducial marker that generates fewer CT artifacts and displays reliably on online imaging system at treatment, and to search for a technique that minimizes artifacts.

Methods: Five sets of different gold markers, 3 carbon markers, and 4 sets of different I-125 dummy seeds in a 30x30x20 phantom were imaged on a Philips multi-slice CT scanner for quantitative analysis. The phantom was also imaged on MVCT, kV-CBCT, kV-OBI, and MV-EPID for visual evaluation. The CT artifacts of the markers were segmented using a program, based on mathematics operation and morphology operation, developed on MATLAB. Up to the 3rd order of moments of each segmented marker artifacts were then calculated. Quantities characterizing the artifacts, such as area, intensity, eigenvalues, etc., were derived and tabulated for comparison.

Results: Eleven sets of CT images were acquired with slice thickness ranging from 0.7 mm to 3 mm and collimation ranging from 1.2 mm to 24 mm. The lower density markers generated almost no CT artifacts, but appeared poorly on online imaging display. All gold markers on the other hand exhibited significant CT artifacts. The severity is related to the mass and dimension of the markers, e.g., Visicoil markers showed the least artifacts. The imaging parameters also demonstrated an impact on the artifacts. For a given collimation, the thinner the slice thickness, the more severe are the artifacts for the same maker. For 2 mm slice thickness settings, 6 and 12 mm collimations produced the least artifacts. The differences diminished when the slice thickness increased to 3 mm.

Conclusions: Lower density markers are unreliable in IGRT applications. All gold markers produced significant CT artifacts. With proper imaging parameters, the artifacts can be effectively reduced. Similar improvement was confirmed on patient CT images. Further investigations will focus on eliminating the CT artifacts.