Purpose:To develop a tomosynthesis cone beam reconstruction algorithm for LINAC cone beam CT with the goal to achieve a dose reduction better than 1/5 in current cone beam imaging protocols for patient positioning and portal beam verification while maintaining the required image quality for patient positioning and beam delivery verification.
Methods:Tomosynthesis is the process of reconstructing tomographic images with fewer acquired projection images and additional synthetically generated projections to preserve image resolution and contrast. We developed a tomosynthesis cone beam reconstruction algorithm based on combining Feldkamp's cone beam reconstruction algorithm and an iterative maximum likelihood reconstruction algorithm. The Feldkamp method is used to reconstruct the first estimate of the tomographic data and the iterative maximum likelihood algorithm improves the resolution, contrast and considerably eliminates ghost images from the first estimate.
Results:The algorithm tests show image reconstruction with the adequate image quality, contrast and resolution for patient positioning and beam delivery verification with a 1/8 dose delivered reduction using current cone beam imaging set-up protocols. Imaging time is reduced with the same proportion allowing higher patient throughput. The algorithm has been tested using patient data for head and neck and brain treatment sites. On both treatment sites, portal beam and patient localization can be effectively performed within 3 mm accuracy using digitally reconstructed radiographs generated from the tomosynthesis reconstructed patient anatomical image. The reconstruction is executed on a desktop computer with 2GHz CPU and 4 Gb RAM in less than 5 minutes.
Conclusions:We developed a tomosynthesis algorithm capable of reconstructing images with adequate resolution to perform beam delivery verification and patient positioning. This dose reduction will allow the daily use of cone beam CT in patients that require daily set-up verification which currently is impractical because of dose and time constraints.