

**Purpose:** CBCT provides useful information for image guidance, however, uncertainty in CT number prevents it from being used for accuracy dose calculation. The purpose of this study is to quantify the accuracy of dose calculation using different CT to density mapping methods and investigate achievable accuracy when applying these methods for dose calculation based on CBCT.

**Method and Materials:** The heterogeneous dose calculated on helical CT (HCT) is used as reference, and the resulting dose from other three methods are compared to reference. In homogeneous dose calculation (HO) method, the density value inside skin contour is overwritten as  $1\text{g/cm}^3$ . In air-bone-soft tissue (ABS) method, the source CT image were replaced by three regions, air, bone, and soft tissue with density overwritten as  $0.1\text{ g/cm}^3$ ,  $1.4\text{ g/cm}^3$ , and  $1\text{ g/cm}^3$  respectively. In stepwise CT density (SWD) method, a CT-density table representing a stepwise function is applied to CT and used in dose calculation. The three methods are applied to both HCT and CBCT on Pinnacle<sup>3</sup> planning system. The resulting dose distributions are compared.

**Results:** Head and neck patients are selected for study. For dose calculation on HCT, the maximum discrepancies in mean dose for HO, ABS, and SWD are within 4%, 2%, and 0.3% for critical organs respectively, and within 1%, 0.5%, and 0.5% for targets. The accuracy results for ABS can be extended to CBCT. For dose calculation on CBCT, dose distribution from ABS is used as reference. The maximum discrepancy between HO and ABS is 2% for critical organs and 0.5% for targets; the maximum discrepancy between SWD and ABS is %1 for critical organs, and 0.5% for targets.

**Conclusions:** Both ABS and SWD can achieve 2% accuracy in dose calculation on CBCT. No contour information is required for SWD, however, normalization of CT number may be necessary.