Purpose:
The primary objective of this study was to explore the feasibility of utilizing the exit-detector-data (EDD) for in vivo quality assurance of head and neck (H&N) cancer patient treatments.

Methods:
Using TomoTherapy's Delivery-Verification (DVS) software we retrospectively evaluated treatments (53 fractions) of ten H&N cancer patients for dose delivery deviations. MV-CT scans covering the entire length of treatment volumes and respective EDD files were used for DVS reconstruction and subsequent dose computation on a GPU platform. Differences between planned and reconstructed sinograms were analyzed to evaluate the leaf-opening time (LOT) differences. Reconstructed dose distributions of fractionated-deliveries were scaled, convolved to estimate composite dose distributions, and compared against planned dose distributions. The dose summation was strictly based on rigid registrations of the fractionated doses and it did not account for soft-tissue/dose deformations. Computed DVHs were strictly based on the plannned contours and they did not include anatomical changes, if any.

Results:
Typical average LOT differences were -3msec-eq with a standard-deviation of 8msec-eq, indicating the integrity of delivered treatments. Although, significant differences were noted for individual reconstructed fraction-doses, the differences in cumulative reconstructed dose-distributions were found to be small. Cumulative reconstructed plans show that the minimal dose (D99%) to the PTV was decreased by 1.6±1.4Gy. Average mean doses of the left and right parotids decreased by 1.0±0.6Gy and 0.8±0.7Gy, respectively. The mean dose and volume receiving >60Gy for the upper-esophagus decreased by 0.7±1.0Gy and 0.6±2.3%, respectively. Overall all the reconstructed doses are lower than the original plans by ~1.0% and this is consistent with our antropomorphic phantom measurements.

Conclusions:
The results of study suggest that EDDs are useful for DVS reconstruction and subsequent dose computation and can be a great tool for in vivo quality assurance of clinical H&N cancer treatments. Further studies are needed to account for deformation effects.