Measurement of Skin Dose from Dental Cone-Beam CT Scans

Innovation/Impact: The field of dental x-ray imaging has changed dramatically over the past decade because of the introduction of cone-beam CT (CBCT) based systems designed for dental imaging. Since 2001, the number of CBCT dental units and the utilization of the CBCT dental imaging procedures have increased rapidly. There have been increased concerns about dental CBCT radiation dose to patients especially to children. The main target organ in cases of CT-induced radiation injury is the skin. On November 21, 2010, The New York Times raised the concern of radiation dose to children from CBCT for dental imaging: “Radiation Worries for Children in Dentists’ Chairs”. In the community, questions have been asked about the relative CBCT dose in comparison to introral radiography, panoramic radiography and medical diagnostic CT. In response to these concerns and questions, recent guidance documents have been developed or are under development by several international groups including the American Dental Association (ADA) which provides guidelines of the safe use of CBCT in clinical practice. AAPM also submitted an official letter in December 2011 in responding to a request from the ADA for comments on the draft guidance document. This highlights the great need for an effective technique to directly measure and monitor patient skin dose during the clinical procedures. However, there currently exist no established techniques to direct measure the skin dose distribution on patients and little published data on measured skin doses. To answer this clinical need, our research is investigating an OSL-based nanoDOT system (Landauer) for direct measurements of patient skin dose from dental CBCT scans of different systems and compared them against measurement results from conventional panoramic and cephalometric dental imaging.

1. A number of radiosensitive tissues of interest were identified for positioning the nanoDOT dosimeters at. A head anthropomorphic phantom was used with nanoDOT dosimeters attached as shown below. To ensure reliable measurement results, three dosimeters were used for each location.

2. Skin dose distribution measured using nanoDOTs. As expected, the results depend on x-ray tube output (kVp and mAs) and also are sensitive to the SFOV: if a dosimeters was entirely or partially included in the radiation field, or was outside the field. In comparing to doses from CBCT systems, doses delivered from the Panoramic and Cephalometric systems are at least lower by an order of magnitude.

3. The peak skin dose was found on Parotid when a CBCT system was used. Sirona and Kodak systems delivered higher doses than other systems. The highest dose from the lens of the eyes was ~4mGy, from the Kodak system. The doses to the eyes from all of the dental imaging systems were significantly lower than the 500mGy threshold dose which may cause cataract development.