CALCULATION OF CONVERSION FACTOR RELATING MEASURED PATIENT ENTRANCE SKIN DOSE AND SCANNER REGISTERED COMPUTED TOMOGRAPHY DOSE INDEX DURING SINUS EXAMINATION.

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Purpose/Introduction

Radiochromic films (RF) have successfully been used in measuring radiation doses in computed tomography (CT). The films were reported to have the ability to picture radiation dose profile, to measure entrance surface dose (ESD), and the peak surface dose (PSD).

The objective of this work was to study the feasibility of using RF as in vivo dosimeters to measure ESD from patients undergoing routine CT examination of the sinus and relate the measurements to the scanner calculated computed tomography dose index ($CTDI_{vol}$) available at the scanner console.

Methods

Gafchromic XR-QA2 film strips were calibrated against the reading from a 300 mm long pencil type ionization chamber calibrated in terms of CT dose length product (DLP) in [mGy.cm].

The in vivo measured ESD and PSD averaged from 12 patients using RF were used to calculate the conversion factors:

$C_S = ESD/CTDI_{vol}$ and $C_{PK} = PSD/CTDI_{vol}$.

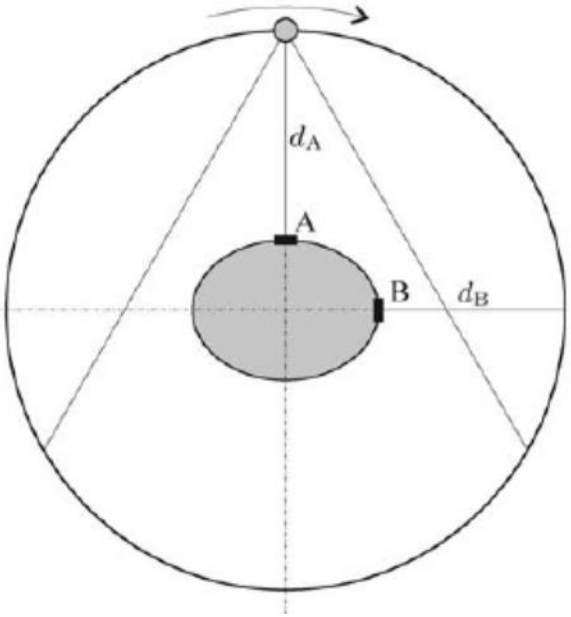

Table 1 : CT Sinus Exam Protocol

parameter	Value
kVp	100
mA	150
Spiral Pitch Factor	0.984
Total Collimation Width	40 mm
Distance Source to Detector	949 mm
Distance Source to Patient	541 mm
Filter Type	MEDIUM FILTER
Convolution Kernel	BONEPLUS
Scanning Mode	Helical
Scanner	GE Light Speed VCT 64 slices

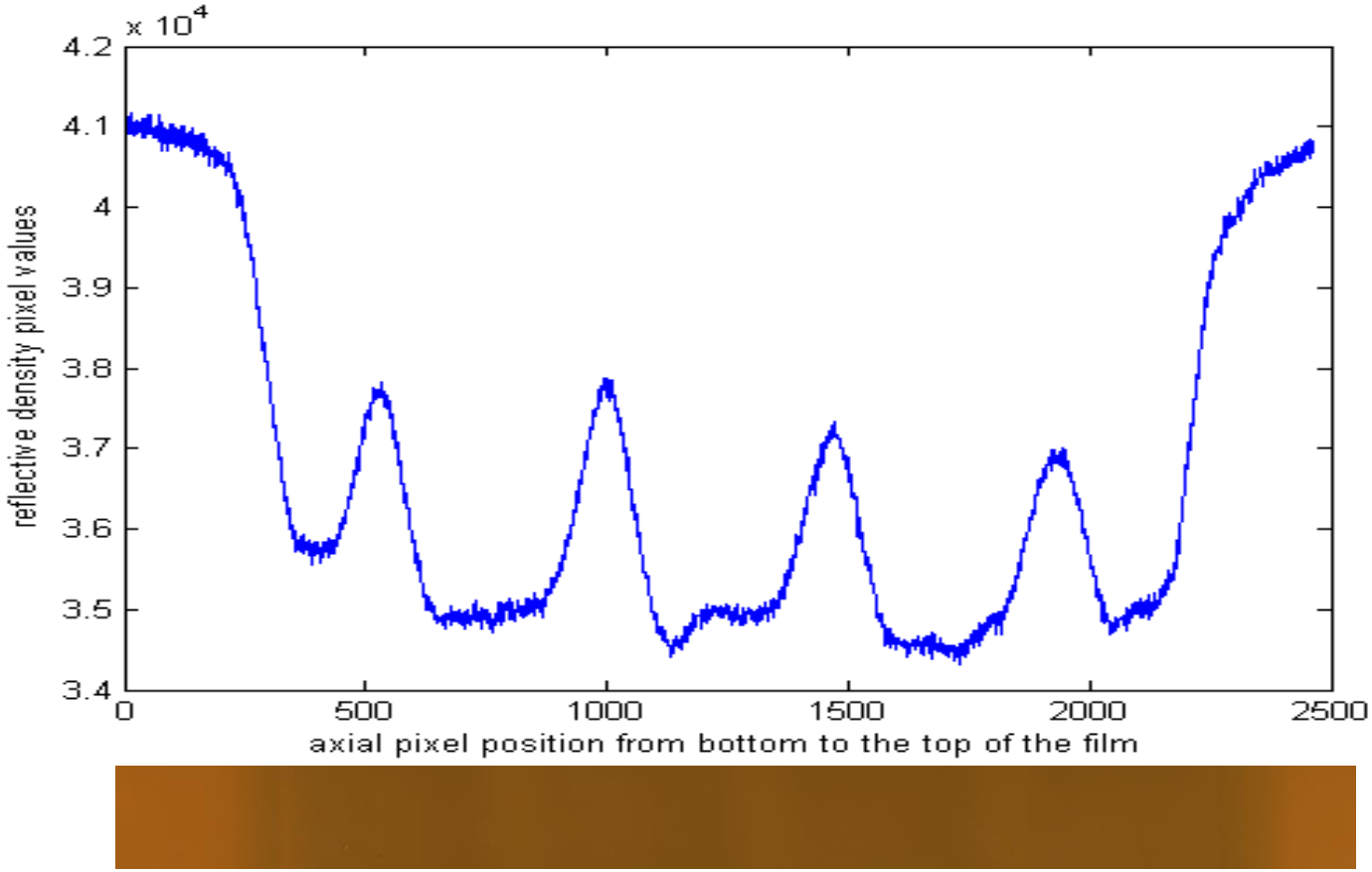

Figure 1: (a) Sinus Exam radiation beam profile captured by the film. (b) XR-QA2 film slice placed under the patient head and analysed after digitization using MATLAB routine. The beam profile is expressed here as reflective density pixel values. We notice the sinusoidal shape of the profile which is a characteristic of the helical mode of acquisition.

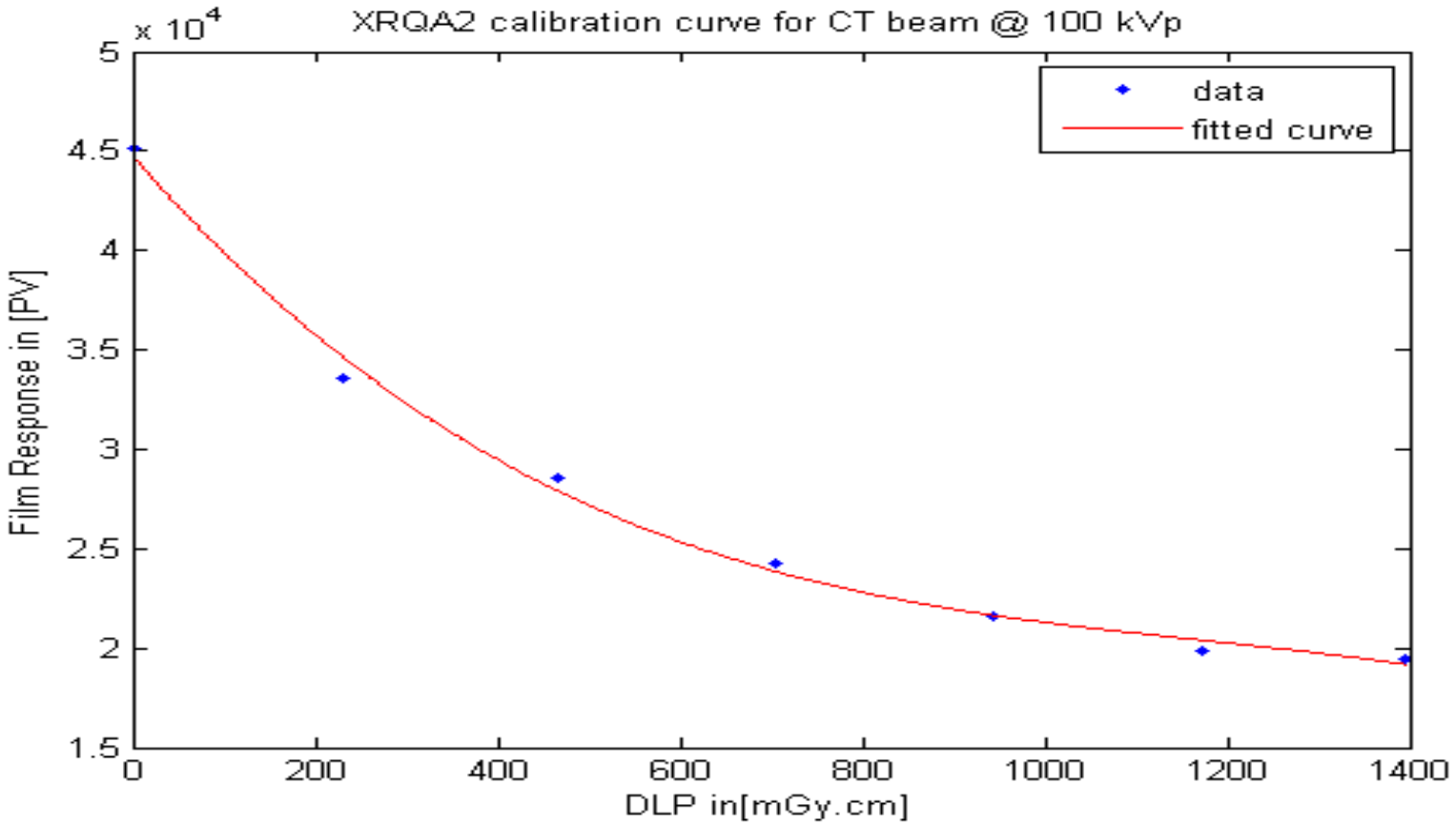

Figure 2: digitized XR-QA2 films in pixel values as function of the DLP in [mGy.cm] measured using 300 mm pencil CT ionization chamber.

Results

The calculated conversion coefficients C_S and C_{pk} were 0.88 and 1.18 respectively. The films were easily and effectively implemented as In-vivo dosimeter during CT imaging of the sinus allowing for a more accurate estimate of typical surface doses found in CT imaging.

Table 2: DLP values for the CT sinus exam for 98 patients

parameter	Average ± SD	Range [min-max]
System registered DLP in (mGy.cm)	210 ±33	165-381
DLP_S in (mGy.cm)	185 ±29	145-335
DLP_{peak} in (mGy.cm)	248 ±39	195-449
System registered $CTDI_{vol}$ in (mGy)	14 ±2	10-27
Scan length in (cm)	15.5 ±1.8	9.4-20.4

Table 3: Reported DLP values from CT Sinus Exam in the literature

Author	Measurement method	DLP in mGy.cm ± SD	kv_p	mA	Pitch	collimation
This work	Radiochromic films Gafchromic XR-QA2	185 ± 29	100	150	0.984	64 X 0.625 mm
Hoxworth, 2014	Values reported at scanner console	406.1 ± 25.9	120	201	0.531	64 X 0.625 mm
Schulz, 2013	Values reported at scanner console	228	120	100	1.00	20 X 0.6 mm
Lam, 2009	TLD-100H	272.8 ± 26.4	120	100	0.55	16 X 0.75 mm

Conclusions

The films had the advantage of not interfering with the patient setup and did not produce any image artifacts. The method can be used to study other CT examinations specially the ones with larger beam width and high pitch factor, to predict the peak skin dose, to examine the CT dose profile and the radiation dose distribution during annual QA.