

# RADIATION DOSE ASSESSMENT OF RADIOSENSITIVE ORGANS USING MOSFET DETECTORS AND MONTE-CARLO BASED DOSIMETRY SOFTWARE PCXMC DURING DENTAL CONE BEAM COMPUTED TOMOGRAPHY EXAMINATIONS

Salman Altimyat, Khaled Soliman, Mousa Bakkari

*Medical Physics Department; Prince Sultan Military Medical City. Riyadh,  
Saudi Arabia*

*saltemiat@psmmc.med.sa*

**1<sup>st</sup>**

**EUROPEAN  
CONGRESS OF  
MEDICAL  
PHYSICS**

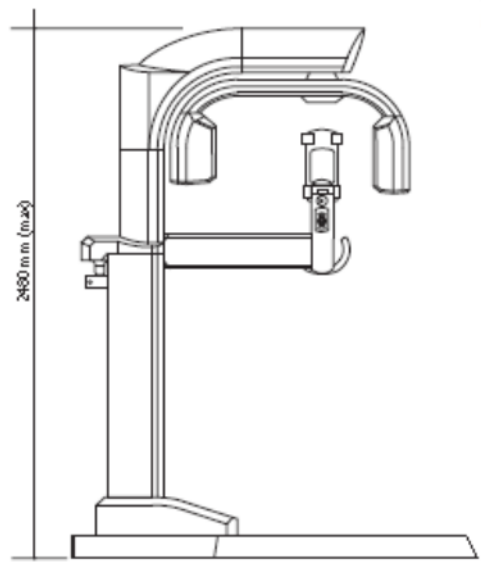
**September 1-4, 2016**  
Eugenides Foundation  
Athens-Greece

## Purpose/Introduction

Dental cone beam computed tomography is a new imaging modality increasingly being used in the oral and maxillofacial radiology, mainly for implant planning and assessment of general bony and dental pathological conditions. European Commission, Radiation Protection No 172, Cone beam CT for dental and maxillofacial radiology, 2012 report mentions; that Medical Physicists are required to routinely monitor radiation doses from such modality.



We propose to establish an easily implemented method to assess the radiation dose delivered to the radiosensitive organs during imaging.



**X-RAY TUBE SPECIFICATIONS**

- Focal spot . . . . . 0.5 x 0,5 mm
- Target angle . . . . . 15°
- Tube Voltage . . . . . 105 kV (100 kV RQT8)
- Anodic Current . . . . . 6 to 10 mA

## Methods

The MOSFET detectors were used to measure the patient eye and thyroid gland radiation doses by placing them directly over the area covering the mentioned organs of the anthropomorphic adult female phantom. The measured doses were compared with the calculated doses using PCXMC software (version 2.0).

### FLAT PANEL DETECTOR

Type . . . . . Amorphous silicon  
Pixel size . . . . . 0.254 mm  
Active Area . . . . . 195 mm x 244 mm

### FIELDS OF VIEWS SIZE

Half Arch. . . . .  $\emptyset$  60 mm x 60 mm  
Dental Arch. . . . .  $\emptyset$  80 mm x 80 mm  
Dental Arch Extended . . . .  $\emptyset$  120 mm x 80 mm  
Full Arch. . . . .  $\emptyset$  150 mm x 130 mm  
Cephalometric . . . . .  $\emptyset$  200 mm x 170 mm

### SCANNING PARAMETERS

Voxel size . . . . . 100 to 500  $\mu$ m  
Voxel type . . . . . Isotropic  
Scanning time . . . . . 18 to 27 s  
X-ray exposure time . . . . . 6 to 9 s  
Reconstruction time . . . . . 30 s

# PCXMC 2.0 INTERFACE

File

Header text   Energy exists

Phantom:

Age:  0  1  5  10  15  Adult

Phantom height  Phantom mass   Arms in phantom

Standard: 174.00 Standard: 71.10

Beam data:

FSD	Beam width	Beam height	Xref	Yref	Zref
<input type="text" value="80.0000"/>	<input type="text" value="20.0000"/>	<input type="text" value="20.0000"/>	<input type="text" value="-0.8840"/>	<input type="text" value="-9.1388"/>	<input type="text" value="81.3292"/>

Draw x-ray field

ProjAngle  Cranio-caudal angle

LATL=0 PA=90 [pos] Cranial X-ray tube  
LATR=180 AP=270 [neg] Caudal X-ray tube

Simulation:

NElevels	Nshots
<input type="text" value="15"/>	<input type="text" value="20000"/>

Rotation increment  View angle

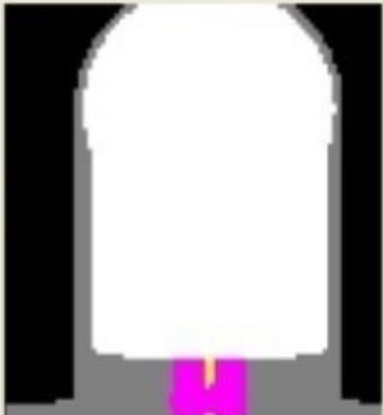
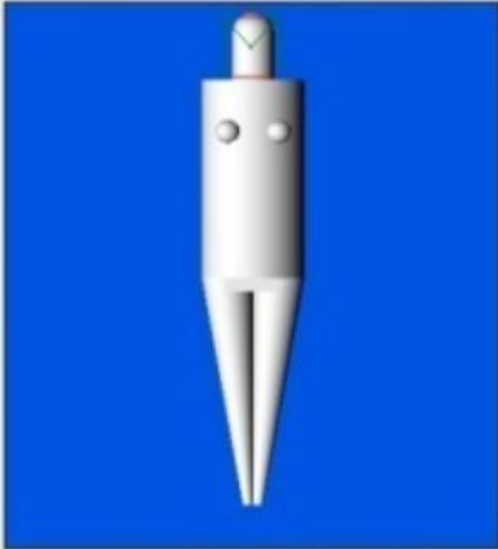
Field size calculator

FID	Image width	Image height
<input type="text" value="110"/>	<input type="text" value="18"/>	<input type="text" value="24"/>

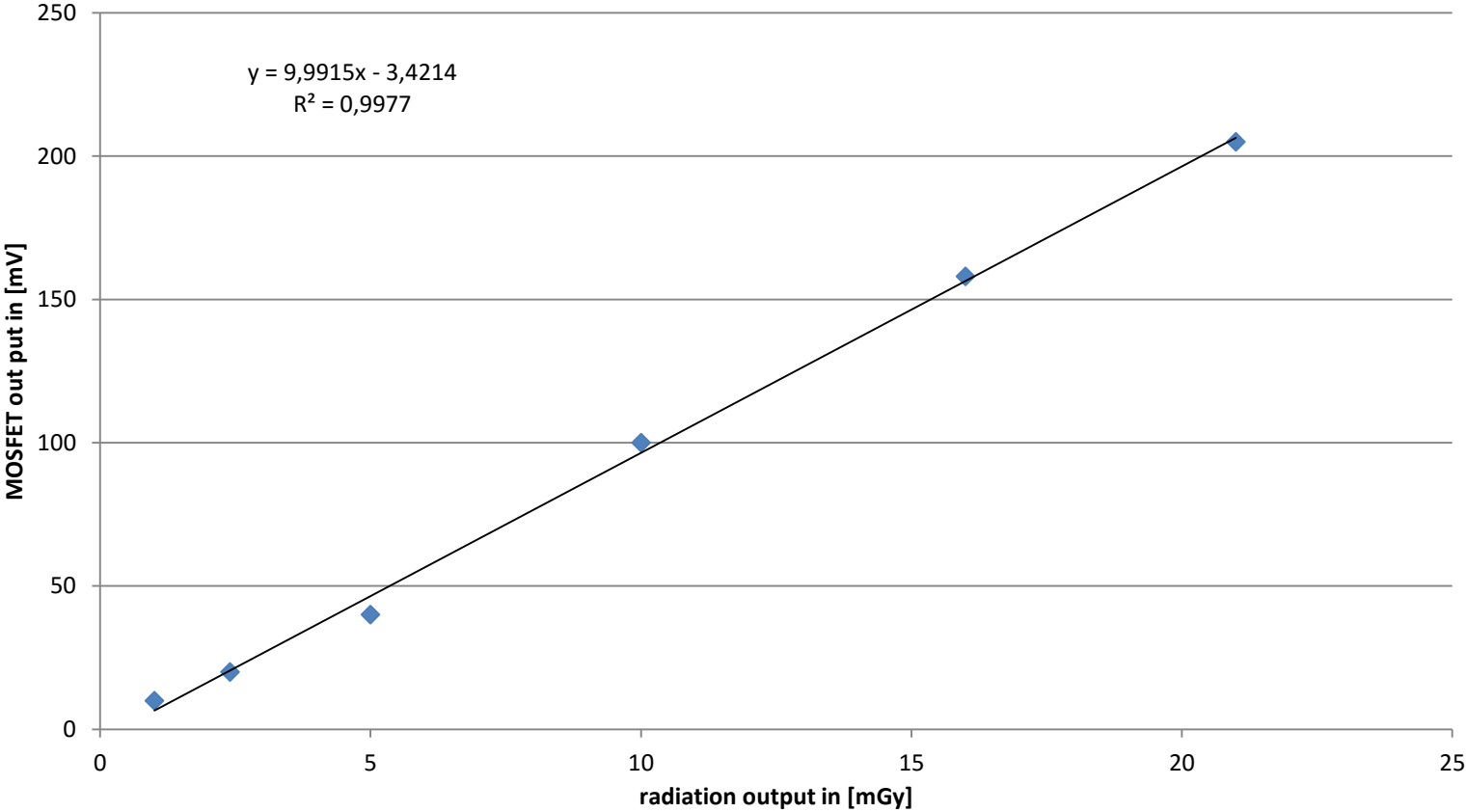
Phantom exit- image distance:

FSD	Beam width	Beam height
<input type="text"/>	<input type="text"/>	<input type="text"/>

- Skeleton
- Brain
- Heart
- Testes
- Spleen
- Lungs
- Ovaries
- Kidneys
- Thyroid
- Stomach
- Pancreas
- Uterus
- Liver
- Upper large intestines
- Lower large intestines
- Small intestines
- Thyroid
- Gall bladder
- Bladder
- Prostate



# MOSFET calibration curve



## MOSFET DOSIMETRY ERROR ANALYSIS

<b>ERROR SOURCE IN (%)</b>		
REPRODUCIBILITY %	4	16
ENERGY DEPENDENCE %	5	25
PHANTOM POSITION X DIRECTION%	15	225
PHANTOM POSITION Y DIRECTION%	15	225
X RAY SOURCE VARIATION %	5	25
PHANTOM TO PHANTOM VARIATION %	10	100
	SUM	616
	ERROR%	25

## Results

Absorbed doses in (mGy) to the skin in the region of the eyes and thyroid were measured.

MOSFET detectors calibration factor was obtained by direct comparison with calibrated standard ionization chamber. The uncertainty factor was 15% for the kV range used by the scanner. The most common DCBCT examination is the full arch high resolution scan conducted at our hospital using the WhiteFox CBCT scanner.

The average measured eye and thyroid doses were 4.3 and 1.2 mGy respectively. The obtained results seem to agree with other published dosimetric studies.



## Conclusions

The presented method can be used to routinely monitor radiation doses delivered to radiosensitive organs as result of imaging studies using DCBCT scanners in clinical environment

