



# Dosimetric Evaluation in Orthopedic Surgeries Guided by Fluoroscopy

Silva, D. A.; Lopes, A. B.; Maia, A. F.  
 Physics Department, Federal University of Sergipe, Brazil  
 afmaia@ufs.br



## 1. Introduction

Fluoroscopy is used in many body systems examinations, with the advantage of providing live and static monitoring of the desired system. With the electronic development, fluoroscopy equipment could become portable, such as the C – arm equipment, called arch. Because it is easy to transportation and it has a design (C-shaped arm) that allows rotation around the patient, the arch is widely used in operating rooms, particularly in cardiovascular and orthopedic procedures.

Although there are no reports of induced injury by radiation due to orthopedic surgery, the increase in these surgeries number requires more attention to patient exposure time during the procedure. Such attention should be even greater in public hospital due to high demand of procedures and workload of medical staff and equipment.

In fluoroscopy, there are two main dosimetric parameters: time of exposition and Dose-Area Product (DAP). DAP is defined as the full dose in a particular area perpendicular to the incident beam [1].

## 2. Objectives

Monitor the Dose-Area Product during orthopedic surgeries in a public hospital in the state of Sergipe.

## 3. Methods

This work was performed in two steps: conducting performance tests [2] on fluoroscopy equipments in the state of Sergipe and dose-area product data collection. The DAP values were measured in a surgery room of a public hospital. For orthopedic surgery, there were always present in the room two surgeons, an anesthetist, a surgical instrument, a nurse, and, when necessary, a radiology technician.

The DAP was measured using a transmission chamber, PTW Freiburg model TA34028-1-11466, and an E2 Diamentor meter, model T11033 - 03074, also PTW Freiburg, Germany. In addition to the total DAP, it were also recorded during the procedure partial values of DAP, as well as some values of tube voltage and current, patient's age, sex and weight and responsible surgeons.

The fluoroscopy equipments used in the evaluated orthopedic surgeries were GE C-arm, model Everview PRO.

Twenty interventional orthopedic procedures were evaluated.

## 5. Discussion and conclusion

DAP values and total times of fluoroscopy obtained in orthopedics were low as compared with other fluoroscopic practices. Several factors affect total DAP measured in orthopedic procedures, mainly the surgeon's experience, the exposure time and the radiological parameters. The estimated dose showed that, among clinical staff, surgeons receive the highest dose, especially in the gonads region. Dose-area product can and should be used along with the total time of fluoroscopy, to characterize patients' dose.

## 4. Results

Table 1. Surgeries distribution.

Surgical procedure	Percentage
Femur	40%
Ulna/Radius	20%
Tibia	15%
Wrist	10%
Elbow	5%
Knee	5%
Ankle	5%
TOTAL	100%

Table 2. Radiological parameters and DAP per procedure.

Procedure	Typical radiological parameters (Tube voltage (kV)/ tube current (mA))		Fluoroscopy time (Range) (s)	Total DAP ( $\mu\text{Gy.m}^2$ )	
	PA	LATERAL			
Femur	73/2.0	108/4.0	46 26 (5-82)	3.2 3.1	x10 <sup>2</sup>
Ulna/Radius	47/0.6	50/0.7	24 12 (10-38)	5.5	2.2
Tibia	56/1.1	53/0.9	65 26 (38-80)	48	20
Elbow	48/0.6	49/0.6	17 3	4.8	0.9
Knee	66/1.6	56/1.0	13 3	22.6	4.5
Ankle	56/1.0	46/0.5	45 9	31.8	6.4

\* projection not used

Table 3. Estimated annual dose in clinical staff, considering an extreme case. (\*not estimated)

Identification	Equivalent dose (mSv)	Effective dose (mSv)
Surgeon (gonads)	3.3 ± 0,2	*
Surgeon (chest)	1.5 ± 0,1	0.10 ± 0.01
Nursing assistant (gonads)	1.7 ± 0,3	*
Nursing Assistant (chest)	1.2 ± 0,2	0.10 ± 0.01
Radiographer (gonads)	0.2 ± 0,1	*
Radiographer (chest)	0.1 ± 0,1	0.01 ± 0.01

## References

[1] INTERNATIONAL COMMISSION ON RADIATION UNITS AND MEASUREMENTS (ICRU). Report n. 74 "Patient Dosimetry for X Rays used in Medical Imaging". Journal of the ICRU, v. 5, n. 2, 2005.

[2] BRASIL. MINISTÉRIO DA SAÚDE, Portaria nº. 453. **Diretrizes de Proteção em Radiodiagnóstico Médico e Odontológico**. Brasília: Diário Oficial da União, 1998.

## Acknowledgements

