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Letter to Editor OMICS International

Factors Affecting Doses for Medical Staff in Orthopaedic Procedures Under X-rays Control

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Interventional medical procedures performed under X-rays control became very popular. Beside of cardiology and neurosurgery, they are implemented also in non-vascular fields, like urology, orthopaedy, gastroenterology, etc. In orthopaedic procedures fluoroscopy is used to control of surgery reconstructions. The ICRP recommendations [1] and Directive of EC [2] implemented as the legal rules in Poland [3] require to use at least 2 individual dosimeters by medical staff participating in interventional procedures (IR). Despite of that, orthopaedic teams are treated as low-risk staff and thus not always are properly monitored. Nevertheless, the need of control radiation risk for this group was proved by the results of dose measurements which were conducted by nearly 3 years (2012-2015) in the orthopaedic clinics of the 3 big hospitals in Lodz (Poland). The detail dosimetric control were submitted the members of medical teams performing osteosynthesis for limb fractures. Two methods were applied: intramedullary (more complicated) and remainder (easier to perform). Each team member was equipped in 4 dosimetric tools containing thermoluminescent dosimeters to measure the equivalent doses for the eyes, skin of the hand and the neck (outside of the shield) and to evaluate effective dose. All the procedures were performed under control of X-ray fluoroscopy. The C-arm units used for that were appropriate technical quality. (Material and methods of the measurements were already described in details [4].) The observations performed during the study were as follows. Although all X-ray devices have pulsed fluoroscopy mode any team did use it! Only in one clinic (the hospital No.2) dose rate was reduced to 50%. Additionally, no member of the teams wore the protective glasses and protective gloves (even the operator). The mean doses per one procedure for operator are given in table 1 below.

Hospital	KAP [cGy.cm2] (Average ± standard deviation)	Dose [mSv]			
		Effective (trunk)	Equivalent for		
			Eyes	Neck	Skin on hand
1	586.6 ± 396.5	0.019	0.042	0.034	0.366
2	246.9 ± 199.2	≈ 0.003	0.029	0.011	0.677
3	722.0 ± 826.0	0.023	0.073	0.061	1.604

Table 1: The mean doses per one procedure for operator and Kerma Air Product (KAP) in the particular hospitals.

The most important conclusions resulting from the dosimetric measurements are following:

The equivalent doses for operator as the most exposed person are (0.029-0.073) mSv and (0.366-1.604) mSv per one procedure for the eyes and skin of the hand, respectively, Significantly higher are the doses during the procedures of intramedullary osteosynthesis (especially for operator) and also a higher impact to Kerma Air Product (KAP) arises from these significant correlation between KAP and equivalent doses for eyes and neck of operator was also found.

Finally, a maximum value of equivalent dose for eyes possible to collect by the operator during one year was evaluated and then compared to the lowered annual limit (i.e. 20 mSv) recommended by ICRP [1]. The result for Hospital No.3 was taken into account, i.e. 0.073 mSv per one procedure. Assuming the number of 300 procedures (mostly intramedullary osteosynthesis ones) are performed during one year by one operator, the maximal equivalent dose for his eyes achieves ≈22 mSv and exceeds the recommended limit of 20 mSv. Such risk can be significantly reduced if lower dose rate (like in Hospital No.2) and/or pulsed fluoroscopy are used , together with individual protective glasses.

References

1. ICRP Statements on tissue reactions (2011) ICRP 4825-3093-1464. Ottawa (ON): ICRP.
2. Directive EC 2013/59/EURATOM.
3. Disposal Minister of Health given in 2006 August 21st concerning the detail conditions of work with radiological devices (Diary of Laws 2006 ,No. 180, position 1325) (in Polish).
4. Staniszewska MA, Kopeć R, Budzanowski M, Owsiak E (2017) Factors affecting exposure level for medical staff during orthopaedic procedures under fluoroscopic control. Med Pr 68: 75-83.