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Research Article

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Intraoperative Radiation Exposure of Orthopaedic Surgeons – Mismatch Between Concerns and Protection

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Abstract

Objective: Although orthopaedic surgeons frequently utilize intraoperative imaging, there is a lack of knowledge about their patterns of radiation protection. The goal of this study was thus to fill this gap by evaluating the use of protection against radiation in relation to concerns, safety guidelines and instructions.

Methods: A survey addressing the issue was performed in 531 orthopaedic and trauma surgeons. The questionnaire comprised 26 questions concerning the use of intraoperative radiation in clinical practice, concerns about it and protection against.

Results: Over 31% of the surgeons are very concerned about their radiation exposure in their job and about 48% are slightly to moderately concerned. Surgeons from Asia-Pacific, Latin America, and Middle East are significantly more concerned about radiation in their job compared to European surgeons ($p<0.002$). However, only one fifth of the surgeons wear a dosimeter and half of them never use it. Nearly 65% of the surgeons always wear a lead apron, but only 30.8% wear a thyroid protection. Lead gloves and lead glasses were always worn by only 2.5 % (13/531) and 3.1% (16/531) respectively. Half of the respondents are aware of the radiation protection officer in their clinic, but 38.8% stated the issue has never been the subject of training at their institution. Internal training significantly affects the usage of dosimeters (odds ratio=2.97, 95% confidence interval: 2.00 – 4.39; $p<0.001$).

Conclusion: Although most operating surgeons worry about their exposure, the knowledge and the practical implementation of radiological protection measures in clinical practice is still insufficient. Education is key for better radiation protection in orthopaedic practice.

Keywords: Radiation Protection; Radiation Safety; Radiation Dosimeters; Fluoroscopy; Orthopedic Surgeons; Occupational Health; Operating Rooms

Introduction

Intraoperative imaging using fluoroscopy is increasing in trauma and orthopaedic surgery due to the development of less invasive approaches. This results in an increasing risk for surgeons of being exposed to ionizing radiation, either by scattered radiation or less often in the primary beam [1,2]. Many studies have investigated the radiation doses surgeons are exposed to during different fluoroscopically guided orthopaedic procedures [3-5]. The highest radiation exposures are observed in spinal surgery and intramedullary nailing of long bones [3,4,6]. Especially, the radiation doses to the hands are critical as surgeons often put their hands into the direct beam to position the extremity during fluoroscopy [7]. The level of exposure depends on the surgical technique and experience of the surgeon that influence the duration of imaging [8]. The distance and position of the radiation source play key roles, and also the imaging unit used may have an impact [1,3].

Ionizing radiation produces a high amount of energy that is absorbed by the tissue leading to direct and indirect effects such as the formation of reactive free radicals, inhibition of cell mitosis, and nucleus damage [9,10]. Within the last decades, an increased risk of cancer has been observed for medical professionals of various specialties exposed to ionizing radiation [11]. It was reported that the incidence of malignant diseases increased among the exposed personnel in an orthopaedic hospital [12] and an increased risk of breast cancer in female orthopaedic surgeons has been detected [13,14].

Methods to reduce radiation exposure in clinical practice are well-known: increased distance from radiation source, decreased radiation exposure time, shielding and contamination control by monitoring of the equipment [1]. Shielding protection is typically achieved using lead garments such as the lead apron which can attenuate 90% of the radiation with the common thickness of 0.25mm [15]. Attenuation of X-rays can also be achieved for other parts of the body, e.g. 20% by wearing normal glasses, between 30 to 70% by lead glasses, and up to 90% by a thyroid gland shield [16]. Sterile protective gloves have been reported to have a large variation in attenuation properties, reducing the exposure from 7% to 50% [17]. Numerous studies have shown the effectiveness of the lead apron and thyroid collar to reduce radiation exposure [18-20].

Surgeons seem often uninformed about the usage of protection gear leading to unnecessary radiation exposure for both the operating team as well as the patients. A recent study reported that the usage of an apron, a dosimeter and a thyroid shield on a regular basis is observed only in 54% of the operating room personnel [21]. Furthermore, there is an inconsistency in education in medical physics and the occupational prevention of radiation exposure in trauma surgeons and medical technical assistants [2,22]. The goal of the present study was to learn about radiation protection patterns of orthopaedic and trauma

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