World Journal of Advanced Research and Reviews

eISSN: 2581-9615 CODEN (USA): WJARAI

Cross Ref DOI: 10.30574/wjarr

Journal homepage: https://wjarr.com/

(Research Article)

Check for updates

Attitudes and practices of orthopedic surgeons when using fluoroscopy in the operating room

TAOUKREO FELNA Ousmane *, ZOFFOUN Orestes, LACHKAR Adnane, YACOUBI Hicham and NAJIB Abedeljaouad

Department of orthopedic, Center Hospitalier Mohammed VI Oujda, Morocco.

World Journal of Advanced Research and Reviews, 2022, 15(02), 593–597

Publication history: Received on 22 July 2022; revised on 22 August 2022; accepted on 24 August 2022

Article DOI: https://doi.org/10.30574/wjarr.2022.15.2.0870

Abstract

Introduction: The aim of this study is to assess the practices and knowledge levels of Moroccan orthopedic surgeons on the possible uses and risks of fluoroscopy and to evaluate methods for preventing radiation damage in the operating room.

Methods: A questionnaire with a total of 16 questions was sent by courier to 180 Moroccan orthopedic surgeons and orthopedic resident physicians practicing in Morocco. The questionnaire assessed participants' knowledge of the uses and risks of fluoroscopy and methods of preventing harm. The effects of fluoroscopy on patients were not evaluated in our study.

Results: The data obtained were statistically evaluated. Of the surgeons surveyed 53.3% were medical specialists, 29.4% were resident doctors and 17.2% were professors. The number of people with more than ten years of experience was 48.9%, only 6.1% of participants had less than one year of experience. 61.1% of surgeons used fluoroscopy between 2 to 5 times per week, almost 8% of participants used the image intensifier more than 10 times per week. Among the surgeons surveyed, 87.2% had never received training on the principles of using fluoroscopy. Dosimeters were not used by 95% of the surgeons surveyed.

Conclusion: According to the survey results, the need for fluoroscopy was very high in orthopedic surgery. However, orthopedic surgeons have inadequate knowledge about the uses and risks of fluoroscopy and methods for preventing damage. Therefore, we believe that training on this topic should be provided to all orthopedic surgeons.

Keywords: Fluoroscopy; Orthopedic surgeons; Radiation protection; X-ray

1. Introduction

Fluoroscopy is one of the most precious tools for an orthopedic surgeon. It is a practical way to explore the indirect anatomy during mini invasive procedures, in reconstructive and pediatric surgery while also decreasing patient morbidity. Using X-ray during surgery exposes both the surgeon and the patient to their well-known adverse effects. Even in small dosage, there is a cumulative effect on the body and dose related a risk of developing cancer [1,2]. Orthopedic Surgeon is particularly at risk due to recurrent use of x-ray imagery and a lack of protectives measures. Those measures allowing for a reduced risk of adverse effects [3]. The aim of this Study is to first recall a set of rules for a proper usage of fluoroscopy in the operating room then evaluate Moroccan orthopedic surgeon's knowledge on those rules,the safety measures in effect and personal protective equipment. Our speculation is that there is a lack of

* Corresponding author: TAOUKREO FELNA Ousmane
Department of orthopedic, Center Hospitalier Mohammed VI Oujda, Morocco.

information amoung orthopedic surgeons and resident on the subject of radioprotection and the appropriate usage of fluoroscopy in the operating room.

2. Material and methods

For the aim of this study, 180 Moroccans orthopedic surgeons were contacted to answer a sixteen questions form. Among them were residents, specialist and professors with an on-field experience from a year to ten.

The survey contained questions about personal information's, radioprotection training and behaviors toward fluoroscopy usage and safety measures. All questions were answered shortly. The data's were analyzed using SPSS v.20.1.0 (SPSS Inc., Chicago, IL, USA), the chi-square test and $p<0.05$ were considered to be statistically relevant.

3. Results

Amount the 180 participants of this study, 96 were specialists, 29,4% were residents and 31 were professors. 48,9% had more than 10 years of on-field experience, only 6,1 % had less than a year of practice. 40,6% were academics practitioner, 35% were in private practice and 31,7% were government physician. 110 of the participant admitted to using X-ray imagery 2 to 5 time a week and approximatively 8% used it more than 10 time a week.

Among the surgeons approached for this survey, 87,2% had never undergone a safety practice training on the use of X-ray imagery. Only 30 of participants knew about the ALARA Principle.

On the subject of a lead apron usage, 6,7% of the participant admitted to never using one, 49,4% used it sometimes and 43,9% always used it . 3.9% always used a cervical lead collar and 121 never used one . 1.7% used protective glasses, 5.6% sometimes used them and 92,8% never used them. 95% of the surgeons approached for this survey didn't use a dosimeter. There wasn't a significate difference of usage of personal protective equipment between both experienced and inexperienced surgeons and based on academic title.

About the appropriate use of an image intensifier, 30 % of the participant stayed very close to the intensifier while using it, 49, 4% took 2 or 3 steps away from it, 19.4 % didn't care about the distance between them and the intensifier and only 5 % stayed 3 meters away while using it.

About the safety distance recommended while using an image intensifier, 42.2 % of the participants didn't know that it was necessary to put about 2 to 3 meters distance between them and the intensifier, 104 participants knew about it . 63,4 % of the participants didn't know that the x-ray emitter tube should be placed under the operating table, 36.6% know about it.

About the participant's preoccupation on being exposed to x-ray in the operating room, 78,9% were preoccupied, 18,9% were often preoccupied and 2,8% weren't. 95,6% of the participants of this study found necessary to introduce training session on radioprotection and the appropriate use of fluoroscopy in the operating room .

4. Discussion

Orthopedic Surgeons and residents are exposed to ionizing irradiation hazard due to proximity to the exposed area [4]. This study was made with the aim to evaluate Moroccan orthopedic surgeons' knowledge on the risk that comes with the use of fluoroscopy, evaluate the safety measures in effect and recall some basic principle of radioprotection. [4].

An image intensifier unit is made out of an electron generator, and emitter tube, a target electrode and an external power outlet. The cathode act as the electron source while the anode is the target .the external power outlet creates an electrical potential difference in the space between both electrodes responsible for the electrons acceleration. X-ray is created by the interaction between electrons and the matter with the conversion of part of their kinetic energy in electromagnetic rays.

X-ray reacts with the bones, soft tissues and air in the body of the patient in different ways. The X-ray which goes through the body of the patient to the target electrode generates a radiographic image. The residual X ray that are not absorbed are deviated and keep their course with a lower energy [5]. That diffusion generates a field of rays responsible for the accidental exposure of users around the image intensifier.

There are many measurements Unit to be understood while describing exposition to x-rays. The Gray (Gy) and Rad are used to measure the amount of ray absorbed by the body, meaning the amount of energy in the matter (being bones or soft tissues). One Gy equal 100 Rads and one joule per kg of matter. The Sievert (Sv) and Roentgen (Rem) are used the measure the equivalent dose. The equivalent dose is used to estimate the biological damage caused by different types of rays absorbed by the tissues. One Sv equal 100 Rem. A set dose of rays will have a different effect depending on the type of rays and the tissue affected. To determine the equivalent dosage (Sv), we multiply the absorbed dosage (Gy) by a quality factor (Q) unique to each type of rays [2].

The effect of radiation on living tissues is produce on a cellular level; cellular components with a fast turnover such as DNA and cellular membrane are more susceptible to damages induced by radiation [5]. This can happen through both direct and indirect mechanisms. Direct damages will occur when the energy is absorbed and molecular links are broken. This can lead to cellular death or altered replication which constitutes the first stage of radiation induced carcinogenesis. Indirect damages occur when H2O molecules are transformed into free radicals; those free radicals have the potential to break molecular links. It is thought that the indirect damages are responsible for the long term effects of radiations [2]. The human body needs to be protected against ionizing radiations. The stochastic effects (cancer and hereditary defects) are covered by the limits of the effective dosage while tissulars reactions (determinist effect) are covered by the limits of dosage for each specific tissue [6]. Mastrangelo G et al [7] demonstrated that orthopedic surgeons have a higher risk of cancer in comparison to unexposed workers. The thyroid gland, the eyes, the hands and the gonads are amoung the most sensible organs to ionizing radiations.

The eyes can present the first effects of chronic exposure to ionizing radiations in the form of cataracts because the crystalline is a radio sensible anatomic structure that needs to be protected from diffusion [8]. 92,8 % of the participants never used protection lead glasses. Lead glasses can reduce eyes exposure to ionizing radiation up to 90% during pelvic and hip surgery [2] .It is though that 85% of papillary carcinoma of the thyroid gland are radio induced [9].

In a study by Nejat Tunçer et al, 95% of participants have experienced headaches and fatigue at least once after a surgery requiring an intensive use of fluoroscopy [1]. In our study, 30% of users never distanced themselves from the image intensifier while using it. The surgeon's hands are most at risk to their constant exposure to radiations. Sterile protection gloves exist but they are not as effective as a lead apron or a cervical lead collar. It should be avoided to place the hands directly on the radiation track as much as possible. Protective gloves cannot replace appropriate technique [2]. Arstein et coll. Have measured the exposition on a cadaveric arm placed at 15 cm and 30 cm from the radiation track, they noticed that the exposure was a hundred time greater when the hand was at 15 cm from the source of radiation .they therefore recommended to avoid leaving the surgeon's hands on the radiation track [10]. In regards to those risks the international commission for radioprotection has established limits dosage of exposition to ionizing radiations. The maximum annual limits is 20 mSv for the body, 150 mSv for the thyroid gland and eyes and 500 mSv for the hands [11]. The use of a dosimeter is fundamental to quantify the dosage to whish the orthopedic surgeons and operating room staff are exposed. In our study, 95% of surgeons didn't use a dosimeter. An enhance use of dosimeter could help determine appropriate level of exposure and doctors could therefore avoid overusing fluoroscopy.

A study made by LP Müller et al shows that during procedures such as femoral and tibial osteosynthesis by Centro medullar rod, the average time of use of fluoroscopy was 4.6 min, the irradiation dose to the surgeon's hand was 1.27 msV, the equivalent dosage to the hand during spine surgery can go up to 5 msV[12]. It should be noted that the maximum dosage for a year is 500 msV for the hands. In a busy unit, it is possible to reach or surpass this maximal dosage easily if personal protection equipment and safety measures are not applied. In our study, 20 % of surgeons used an image intensifier more than 5 time a week, 83.9 % had no knowledge about radioprotection and 87.2% had never undergone training on the proper use of fluoroscopy which increase the risk of surpassing the maximum dosage established by CIPR.

Even thou it has been proven that ionizing radiation in normal dosage does not cause skin cancer, an extensive exposure to ionizing radiation like radiotherapy is known to cause skin cancer. Therefore incorrect or excessive use of fluoroscopy can lead to excessive exposure to ionizing radiation thus increasing the risk of cancer [1]. Orthopedic surgeons are exposed to diffused radiations and rarely directly exposed during surgery. The adverse effects or ionizing rays are minimized by wearing lead protective personal equipment (apron, skirt, glasses and collar). Studies have demonstrated that the use of proper personal protective equipment reduces by 90 to 97% the exposure of the operator [11 ; 13]. In our study, 49.4% of surgeon didn't a lead apron, 67.2 % never used a cervical collar. LP Müller and al have demonstrated that the average ionizing dosage is increased by a factor of 70 without a lead cervical collar[12]. In a Canadian cohort study by Jan M Zielinski and al on 67562 health professionals exposed to ionizing radiations on a low dosage confirm the risk of health workers exposed to radiations to develop cancer even while wearing adequate thyroid Ian protection[14].

In addition to reducing direct exposure to ionizing radiation and wearing personal protection equipment, knowing the direction of diffusion of rays can further reduce exposition. The ALARA principle is based on reducing the amoung of rays delivered without altering the image. Obtaining an image should be a priority before the risk taken by the operating room staff, even exposure to ionizing radiation. Furthermore, it is important to obtain the necessary diagnostic information with the least amoung of exposure .this principle should be kept in mind while using an image intensifier to ensure the safety of the patient, the surgeon and the operating room staff[2 ; 15]. Knowledge about the direction and the intensity of diffusion of ionizing rays can help reduce exposition. The highest level of dispersion occurs between the emitter tube and the patient (primary area of radiation). This can generate higher level of dispersion at the legs, feet, head, eyes and neck of the surgeon depending on the position of the image intensifier. This explains why the emitter tube should be placed under the operating table. In our study 30.6% of users didn't know where the emitter tube should be placed to lower the exposition of the surgeon. Laser targeting is another measure to lower the surgeon's exposition. Alonso and coll reported that diffused ionizing radiation is insignificant outside of a 2 meter radius from the source (safe zone) [16]. In our study, 42.2% of users didn't know about this 2 meter radius safety zone. Oddy MJ and al reported a correlation between the on-field experience of the surgeon and their exposition to ionizing radiation, the more experienced the surgeons the lower the exposition due to lesser use of the image intensifier [17]. In our study, 29.4% of participants were orthopedic surgeon in training, they were therefore more exposed to ionizing radiations while in the operating room as lead surgeon .95.6% of surgeons approached for this study have expressed the need for training sessions on safety radioprotection measures in the operating room which shows their concern .

5. Conclusion

One of the most important conclusions of this study is that most of the participants didn't have proper technical knowledge about the use of an image intensifier. Future efforts to implement educational programs focused on safety measures are needed to minimize intraoperative radiation exposure. Some recommendations and safety measure seems necessary:

- Training session on radioprotection are required for the operating room staff
- The use of personal protective equipment such as dosimeter, lead apron glasses, cervical collar and gloves are mandatory.
- The image intensifier should be operated by certified staff as much as possible to avoid unnecessary exposure.
- All the operating room staff should step away from the image intensifier while using it to reduce the effect of diffused radiations.
- The patient should be closer to the target electrode and further from the emitter tube to minimize diffused radiation.
- It should be avoided to leave the hands directly on the primary radiation beam.
- The total time of use of fluoroscopy during the interventions should be reduced to a minimum
- Lead apron should be hanged and not folded after use to avoid deterioration
- Lead aprons should be inspected regularly to detect any leaks
- The laser target, if there is any, should be used to reduce exposition to ionizing radiations,
- It should be avoided to handle to emitter tube directly while using it
- The ALARA principle should be applied
- Exposure to ionizing radiation is harmful and safety measures should be applied to minimize it.

Compliance with ethical standards

Acknowledgments

This work is dedicated to my masters of the orthopedic department of the university hospital center Mohammed VI in Oujda in MOROCCO

Disclosure of conflict of interest

The author declares no conflict of interest.

Statement of ethical approval

The present research work does not contain any studies performed on animals/humans subjects by any of the authors.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

References

[1] Nejat Tunçer, Ersin Kuyucu, Şafak Sayar, İbrahim Tuncay. Orthopedic surgeons' knowledge regarding risk of radiation exposition: a survey analysis . SICOT J. 2017, 3: 29.

[2] Daniel J. Kaplan, Jay N. Patel, Frank A. Liporace, Richard S. Yoon. Intraoperative radiation safety in orthopaedics: a review of the ALARA (As low as reasonably achievable) principle. Patient Saf Surg. 2016, 10: 27.

[3] Jacob K, Vivian G, Steel JR) X-ray dose training: are we exposed to enough? Clin Radiol .2004 Oct, 59(10):928-34

[4] Anupam Mahajan, Sumant Samuel, Atul K Saran, M K Mahajan, M K Mam. Occupational Radiation Exposure from C Arm Fluoroscopy During Common Orthopaedic Surgical Procedures and its Prevention. J Clin Diagn Res. 2015 Mar, 9(3): RC01–RC04

[5] Hafez MA, Smith RM, Matthews SJ and al. Radiation exposure to the hands of orthopaedic surgeons: are we underestimating the risk? Arch Orthop Trauma Surg. 2005, 125 (5): 330–335. doi: 10.1007 / s00402-005-0807-5.

[6] F.A. Stewart, AV Akleyev, M. Hauer-Jensen, JH Hendry, NJ Kleiman, TJ MacVittie, BM Aleman, AB Edgar, K. Mabuchi and al . ICRP Statement on Tissue Reactions/Early and Late Effects of Radiation in Normal Tissues. CIPR 118, Ann. 2012

[7] Giuseppe Mastrangelo, Ugo Fedeli, Emanuela Fadda, Angelo Giovanazzi, Luca Scoizzato, Bruno Saia. Increased cancer risk among surgeons in an orthopaedic hospital. Occup Med (Lond).2005 Sep, 55(6):498-500

[8] Chandrasekharan Nair Kesavachandran, Frank Haamann, Albert Nienhaus. Radiation exposure of eyes, thyroid gland and hands in orthopaedic staff: a systematic review. Eur J Med Res. 2012 Oct 30, 17(1):28

[9] Devalia KL, Guha A, Devadoss VGActa Orthop Belg. The need to protect the thyroid gland during image intensifier use in orthopaedic procedures 2004 oct, 70 (5): 474-7

[10] Arnstein PM, Richards AM, Putney R. The risk from radiation exposure during operative X-ray screening in hand surgery. J Hand Surg (Br) 1994, 19:393–396

[11] Quinn AD, Taylor CG, Sabharwal M, Sikdar T . Radiation protection awareness in non-radiologists. Br J Radiol 1997, 70, 102–106.

[12] L P Müller, J Suffner, K Wenda, W Mohr, P M Rommens. Radiation exposure to the hands and the thyroid of the surgeon during intramedullary nailing. Injury. 1998 Jul, 29(6):461-8

[13] Amir Matityahu, Ryan K Duffy, Sabine Goldhahn, Alexander Joeris, Peter H Richter, Florian Gebhard . The Great Unknown-A systematic literature review about risk associated with intraoperative imaging during orthopaedic surgeries. Injury. 2017 Aug, 48(8):1727-1734

[14] Jan M Zielinski 1, Michael J Garner, Pierre R Band, Daniel Krewski, Natalia S Shilnikova, Huixia Jiang. Health outcomes of low-dose ionizing radiation exposure among medical workers: a cohort study of the Canadian national dose registry of radiation workers. Int J Occup Med Environ Health. 2009, 22(2):149-56

[15] Hendee WR, Edwards FM. ALARA and an integrated approach to radiation protection.Semin Nucl Med. 1986 Apr, 16 (2): 142-50.

[16] Alonso JA, Shaw DL, Maxwell A, McGill GP, Hart GC .Scattered radiation during fxation of hip fractures, Is distance alone enough protection? J Bone Joint Surg Br.2001, 83(6):815–818

[17] Oddy MJ, Aldam CH.Ionising radiation exposure to orthopaedic trainees: the efect of sub-specialty training. Ann R Coll Surg Engl. 2006, 88:297–301