SAFER MOBILE FLUOROSCOPY IN THE TRAUMA THEATRE: A SURVEY OF ORTHOPAEDIC REGISTRARS AND THEATRE STAFF

T Hunter Clinical Fellow1
N Jayasekera Arthroplasty Fellow1
R Roach Consultant Orthopaedic Surgeon2
1Robert Jones and Agnes Hunt Orthopaedic Hospital NHS Foundation Trust
2Shrewsbury and Telford Hospital NHS Trust

According to IR(ME)R, the surgeon directing the mobile fluoroscopy is considered the practitioner. Trauma theatre staff are considered neither practitioner nor operator and would therefore not require mandatory training. We hypothesised poor uptake of the IR(ME)R course by orthopaedic registrars, with potential risk of unnecessary radiation exposure to clinician, theatre staff and patients.

Methods

A total of 96 orthopaedic specialist registrars from hospitals in Oswestry, London and Manchester as well as 25 trauma theatre staff (10 operating department technicians, 9 theatre nurses, 6 theatre auxiliary nurses) were contacted by questionnaire survey (Figure 1) between 2007 and 2012. The sample of orthopaedic trainees was obtained from those attending mandatory weekly regional teaching sessions, while the sample of trauma theatre staff was from volunteers from the theatre department willing to participate in the survey. All participants were advised to answer questions unassisted. All orthopaedic registrars had independent operating experience for trauma with use of mobile fluoroscopy and all theatre staff worked routinely in the trauma theatre. The sample of orthopaedic trainees was obtained from those attending mandatory weekly regional teaching sessions, while the sample of trauma theatre staff was from volunteers from the theatre department willing to participate in the survey. All participants were advised to answer questions unassisted. All orthopaedic registrars had independent operating experience for trauma with use of mobile fluoroscopy and all theatre staff worked routinely in the trauma theatre. All those polled worked at institutions with a radiology and theatre department policy for radiographer operated mobile fluoroscopy.

Statistical analysis was performed using Wilcoxon rank and Fisher’s exact tests. A p-value of <0.05 was considered statistically significant.

The Ionising Radiation (Protection of Persons Undergoing Medical Examination or Treatment) Regulations 1988 (POPUMET) made it compulsory from June 1990 for all staff directing medical exposures to ionising radiation to receive formal tuition at a core knowledge course. This course described the hazards of ionising radiation and the safe use of x-ray equipment. It instructed on the nature of ionising radiation and its interaction with tissues, principles and means of dose reduction to patient and operator, the importance of using the patient’s existing radiological information and statutory responsibilities. The POPUMET course was discontinued following the Ionising Radiation (Medical Exposure) Regulations 2000 (IR(ME)R). IR(ME)R training for healthcare professionals is available as a half-day theoretical course suitable for those designated as ‘referrer’ by their employers. Other locally run ionisation protection courses are tailored to the varied requirements of a spectrum of healthcare professionals.

Over the past 30 years, the mobile fluoroscopy unit has become an indispensable tool of the orthopaedic surgeon. Fluoroscopy exposes patients and theatre staff to ionising radiation with potential harmful effects. Previous studies have analysed exposure of orthopaedic surgeons to ionising radiation in theatre. As quoted by Herscovici and Sanders, the three variables that control this exposure are:

- mechanical (determined by the amount and duration of exposure as well as direction of the radiation beam)
- barriers (which require use of protective devices)
- span (determined by the working distance between staff and fluoroscopic unit).

Under IR(ME)R, it is the responsibility of staff directing medical exposures to ionising radiation to optimise the above mentioned variables so that effective screening may be achieved with the least radiation exposure to patients and staff. Giannoudis et al demonstrated statistically significant differences between administered radiation doses in theatre and the technician’s level of experience. It is logical for the surgeon to require a sound working knowledge of mobile fluoroscopy and awareness of ionising radiation protection issues to direct the radiographer safely in theatre. This view is corroborated by a 90% reduction in screening times achieved after introduction of a teaching programme for orthopaedic surgeons who use fluoroscopy.

According to IR(ME)R, the surgeon directing the mobile fluoroscopy is considered the practitioner. Trauma theatre staff are considered neither practitioner nor operator and would therefore not require mandatory training. We hypothesised poor uptake of the IR(ME)R course by orthopaedic registrars, with potential risk of unnecessary radiation exposure to clinician, theatre staff and patients.
Results
The questionnaire was completed by 85 of the 96 registrars and all 25 theatre staff. A summary of the results is shown in Figure 2. During lateral views for hip fracture fixation, all trainees selected the x-ray tube position between the patient’s thighs. Eight trainees (9%) and two theatre staff members (8%) had received formal ionising radiation training. Those polled who had received formal ionising radiation training all correctly identified the x-ray tube, least frequently screened their hands (average less than once a year), most frequently wore adequate radiation protection and routinely stepped away from the x-ray tube during fluoroscopy. There was a statistically significant difference (p<0.001) between registrars and theatre staff for use of adequate radiation protection barriers.

Discussion
Only 9% of registrars had received formal ionising radiation training. This is a poor uptake and raises concerns regarding effective implementation of training. Registrars and trauma theatre staff had similar levels of training in ionising radiation protection even though trauma theatre staff are classed neither as practitioners nor as operators of the mobile fluoroscopy units as defined by IR(ME)R.

The inability of 38% of registrars to correctly identify the x-ray tube demonstrates a deficiency of basic knowledge, which may potentially lead to inappropriate ionising radiation exposure for staff and patients when fluoroscopy is directed by the surgeon. There is also a risk of close proximity of the surgeon to the x-ray tube during fluoroscopy, which may result in unnecessary exposure. All registrars used position A (x-ray tube between the patient’s thighs) for lateral imaging of the hip, although this is likely to be due to the correct orientation of the fluoroscope by the radiographer to accommodate anteroposterior imaging of the hip and minimise exposure of the surgeon to scatter radiation2 rather than an informed decision by the surgeon.

The inability of 76% of registrars to locate x-ray beams correctly within the energy spectrum demonstrates a deficiency in understanding of the basic science of fluoroscopy. Furthermore, 76% of registrars also failed to appreciate that their peripheries are at greatest risk of accumulative exposure to ionising radiation, which may explain the 69% who screen their own hands at least once a month and the 85% who have their hands in close proximity to the x-ray beam.

In light of the apparent poor knowledge and practice of orthopaedic registrars with regard to the image intensifier, we believe the relative sparing of theatre staff to ionising radiation exposure is attributable to operating theatre dynamics rather than a concerted effort towards safer practice. Irradiation of the surgeon with particular emphasis on scatter radiation has been highlighted in previous reports.4,13 Extremity (ie hands) dose has been identified as the limiting factor in radiation exposure in orthopaedics, with recommendation for the use of lead rubber gloves when screening at close proximity.2 Noordeen et al advocate keeping hands far away from the x-ray beam4 and yet 69% of registrars screen their hands at least once a month.

The majority of registrars remained within 60cm (approximately an arm’s length) of the irradiated area and only six registrars wore a lead thyroid shield as suggested by Alonso et al.12 Significant radiation exposure has been reported in individuals working with inadequate protection within 70cm of a fluoroscopic beam.13 Despite this, a fifth of registrars routinely wore insufficient protection within this zone. Smith et al advocate standing back during screening6 but only ten subjects polled did so routinely.

There appeared to be safer practice and better knowledge among registrars and theatre staff who had completed
formal training. Poor uptake of the IR(ME)R course by our cohort is a significant concern.

Study limitations
We acknowledge limitations in the assessment method, despite use of a well-designed questionnaire. We also realise that more senior registrars may be better informed through experience rather than formal training. Analysis of data did show a trend towards better and safer practice in the cohort who had undergone formal training. It is likely the limited sample size masked greater demonstrable differences between those with and without core knowledge training. Power analysis showed that a sample size of 679 would be required to demonstrate significant differences in theatre practice between those trained and untrained.

Despite these shortcomings, we feel this simple tool was sufficient to adequately demonstrate important deficiencies. We believe that surgeons should be knowledgeable prior to starting their specialty training rather than learning on the job from hearsay, practical errors and feedback from other theatre staff. This is a dangerous scenario that can be remedied easily by strict and proactive enforcement of IR(ME)R training, which remains the responsibility of the employer. We also feel it important for the radiographer to appreciate this potential knowledge gap in radiation protection when in theatre.

Conclusions
We believe the IR(ME)R course should be imposed stringently as a mandatory prerequisite to orthopaedic training. We propose further instruction in ionising radiation protection early in the orthopaedic training programme. In view of the routine use of mobile fluoroscopy in trauma and elective orthopaedic procedures, this should result in greater cooperation and understanding between radiographer and surgeon, and lead to better and safer practice.

Acknowledgements
We thank Mr Khalid Sharif and Mr Rupert Indhar for their assistance during data collection. We also thank all participants of the survey.

References