Intraoperative Radiation Use by Trainees During Ankle Fracture Fixation

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abstract

Orthopedic trainees are assessed during training regarding their use of radiological screening during operative procedures. The authors investigated whether orthopedic trainees’ use of fluoroscopic screening during ankle fixation operations varied with the 2 variables of consultant supervision and trainee experience.

Data from operative fixation of isolated Weber B ankle fractures were reviewed. The intraoperative radiation dose was retrieved from radiographers’ data. Operations performed by consultants were used as a control group (n=25 patients). Trainee supervision was assessed as “trainer in operating room (OR)” and “trainer out of OR.” Regarding experience, the patients were divided into those operated on primarily by trainees in their first (n=36 patients) and in their last (n=34 patients) 3 years of formal specialist training. All trainee groups used more radiation than consultants. Supervision did not affect the radiation use of senior trainees ($P<.05$). Senior trainees used less radiation than their junior peers ($P<.02$). Junior trainees supervised by a trainer in the OR used less radiation than junior trainees supervised by a trainer outside of the OR ($P<.05$).

During open reduction and internal fixation of ankle fractures, junior orthopedic trainees use less intraoperative radiation when they are supervised by a trainer in the OR. The more experience a surgeon has, the less fluoroscopic screening is used during operative ankle fixation.
Orthopedic trainees’ operative abilities are assessed during several key operative procedures, including internal fixation of ankle fractures. Trainees record these procedures on the electronic logbook portal (PanSurgical eLogbook; The Royal College of Surgeons, Edinburgh, Scotland). Several different levels of consultant supervision can be recorded: supervising surgeon scrubbed, surgeon unscrubbed but present in the operating room, and no supervision provided.

Fluoroscopy screening is commonly used during operative ankle fixation. Intraoperative fluoroscopy exposes both the patient and operating room personnel to ionizing radiation and its adverse effects. The amount of radiation received by the operating room surgical staff and patient is directly proportional to the screening time (when the image intensifier is actively generating a radiographic beam). It is also inversely proportional to the level of experience of the surgeon.

The goal of the current study was to investigate whether the use of fluoroscopic screening by junior orthopedic surgeons varied with trainee experience and the level of trainer supervision.

**Materials and Methods**

The radiation dose during operative fixation of ankle fractures was assessed against 2 criteria. The first was the seniority of the surgeon. Patients were divided into 3 groups based on the grade of the primary surgeon: consultant (n=25 patients), senior trainee (more than 3 years of orthopedic training; n=34 patients), and junior trainee (fewer than 3 years of orthopedic training; n=36 patients). The second was the level of consultant supervision of trainees. Trainee operations (both senior and junior) were divided into those with a trainer in the operating room (OR) and outside of the OR.

Operative fixation of only 1 type of injury was studied: an isolated Weber B lateral malleolar fracture. All fractures were treated in the same way: with open reduction and internal fixation using a plate and screws. Any injuries involving syndesmotic injuries requiring fixation, Weber C fractures, fractures involving the medial malleolus, and compound (open) fractures were excluded.

Radiation dose from the fluoroscope was recorded and expressed in gray square centimeter (cGy/cm²). The same image intensifier was used in all cases (Siemens-Siremobil 2000; Siemens Medical Solutions Group, Eschborn, Germany) and operated by radiographers. The radiation dose was calculated by entering the dose area product into the clinical radiology imaging system, which is then converted into cGy/cm². A calibrated dose area product meter recorded the exposure of the patients to radiation in units of cGy/cm². Data regarding the trainees’ grade and supervision were collected from their logbooks. A tourniquet was used in all cases, and the time, expressed in minutes, was recorded in all cases. Postoperative data with regard to weight bearing and complications such as infection were retrieved from patients’ notes up to 1 year postoperatively.

Data on radiation dose were considered to be nonparametric, and therefore the Mann-Whitney U test was used. For other categorical data, the Fisher exact test was used. Data on tourniquet time were considered parametric, and the unpaired Student’s t test was used. The difference between the results was considered statistically significant when the P value was .05 or less.

**Results**

**Surgeon Seniority**

The dose of radiation used reduced as surgeon experience increased. Consultants (median radiation dose, 6.5 cGy/cm²) used less radiation than senior (median radiation dose, 11.2 cGy/cm²) (P<.05) and junior (median radiation dose, 36.3 cGy/cm²) trainees (Mann-Whitney U test, P<.02) (Figure 1).
Level of Supervision

For senior trainees, the level of supervision did not affect radiation dosage ($P > .05$). Junior trainees who were supervised by a trainer in the OR used less radiation than junior trainees supervised by a trainer outside of the OR ($P < .05$). More direct supervision was provided to trainees in their first 3 years of training (25 in the group in the OR vs 11 in the group outside of the OR; $P < .002$) (Figure 2).

Tourniquet Time

No difference existed between consultants’ and trainees’ tourniquet times. Tourniquet times were similar among trainees, irrespective of their level of experience and the level of trainer supervision (Table 1).

Clinical Outcome

All patients wore a cast for at least 2 weeks postoperatively to permit skin and soft tissue healing. Based on the quality of bone (judged intraoperatively), the fracture pattern, and the patient’s age, weight bearing was allowed from postoperative week 2. However, all patients achieved full weight bearing by postoperative week 8. Infection occurred in 3 cases. Two infections were superficial and were treated successfully with antibiotics. One infection was deep and required removal of metal and the application of an external fixator for continuous wound management. Further clinical details are shown in Table 2.

**DISCUSSION**

This study shows that consultant supervision during operative fixation of ankle fractures has an effect on reducing the intraoperative use of radiography screening by junior orthopedic trainees. Irrespective of the level of supervision received, trainees in their last 3 years of training used less radiation compared with their peers in the first 3 years of training. Therefore, trainees improve their use of intraoperative radiography as they progress in their training.

Previous studies showed that trainees’ surgical performance is directly proportional to their level of experience. To the current authors’ knowledge, this is the first study to date to investigate the use of intraoperative radiography against the level of supervision provided and the trainees’ level of experience. The profligate use of screening by junior trainees in the study may be explained by lack of confidence when the trainer was not present in the OR.

Due to the risks posed by radiation, even at low doses, it is important that the intraoperative radiation dosage to patients, surgeons, and operating room staff is minimized. Previous studies have investigated the use of intraoperative radiography with the aim of establishing local diagnostic reference levels. The current authors suggest that their data be used to set acceptable levels of radiation for Weber B ankle fixation procedures. Excessive use of intraoperative fluoroscopy may be used as a marker of lack of confidence and trainer supervision. Further study is being undertaken to set similar standards for other key procedures, such as hip and wrist fracture fixation, against which trainees can be assessed appropriately on the relevant PBA form.

**REFERENCES**


