Dose Reduction in CT Fluoroscopy

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14.1.1 Radiation Risk

A drawback of CTF is the potential for significantly high patient and staff doses. This is reported by several authors and also by competent bodies such as UNSCEAR in their 2000 report and ICRP in their report “Managing patient dose in computed tomography” (ICRP 2000). The interventional nature of CTF requires specific radiation protection considerations compared to conventional CT.

First of all, the patient skin dose is of concern. Since the scanning plane is kept constant during the entire procedure, the same skin area is repeatedly exposed and cumulative patient skin doses can be substantial, which may reach deterministic thresholds for radiation injuries. Maximum patient skin dose is therefore the risk-related quantity of concern, rather than the effective dose received by the patient. Effective dose from CTF is usually in the same order of magnitude as doses from diagnostic CT scans due to the small patient volume irradiated. With CTF, the user can select high exposure settings in terms of high tube potentials (120 kVp) and high tube currents (90 mA). These are high values when compared to the exposure factors used in, for example, vascular interventional radiological (IR) procedures. This results in substantial skin dose rates. Also, prolonged CT scanning times can be necessary in cases of small lesions that are difficult to access.

In contrast to conventional CT where the operator is protected behind the lead screen of the console, CTF procedures require the presence of the staff in the examination room during CT scanning (Fig. 14.1). As a result, the operator is exposed to an intense scatter radiation field. For such IR procedures it is standard practice for the medical staff to protect themselves by wearing a lead apron. A lead apron efficiently shields most important organs, reducing the effective dose received by the individual. However, surface doses to the parts of the body that are not shielded by the apron can be substantial. These are in particular the doses to both hands and the dose to the head (eyes). Also, information about these doses is often unavailable, as they are not monitored routinely. The dose to the hands is of particular concern due to its proximity to the scanning plane, and although it is unacceptable and every effort must be made to keep the hands out of the primary beam, the risk exists and it has been reported (Fig. 14.2). A CT room is usually

Fig. 14.1a,b. The presence of staff in the examination room during CT scanning can lead to their exposure to an intense scatter radiation field, especially of body parts not protected by the lead apron.

Fig. 14.2. The hand of the operator entering the primary beam during a CTF procedure.