



Agenda 5 e. updated

ISRRT Position Statement:

Patient contact shielding, including gonad shielding, on patients for diagnostic radiography procedures and Computed Tomography (CT).

The ISRRT has become aware of several articles and position statements relating to guidance on the use of shielding on patients including gonad shielding.

These documents, produced by a number of learned organisations and professional societies^{1,2,3}, support a change in the conventional use of direct patient shielding recommending that in the majority of situations that their application and use is no longer necessary.

The ISRRT endorses the change in practice which is based on latest scientific research and risk benefit assessments^{1,2,3}. However, any change in practice must be consistent with any specific national and local legislative guidance, protocols, and procedures where medical imaging is employed.

The ISRRT supports the leading role that radiographers undertake in the decision-making, application and communication processes of this issue and particularly their foremost position in patient radiation dose optimisation advocacy and public awareness regarding radiation dose.

Background Information

This section contains brief information on the relevant issues pertaining to patient shielding and should be read in conjunction with national and professional societies' guidance and advice specific to the country readers are working in and taking into account any national legal recommendations. The narratives described below build on the narratives of recent publications^{1,2,3}.

- **Description – medical device – care and infection control**

Patient shielding devices that are supplied in several countries are categorised as medical devices due to the fact that they are placed on the patient⁵. Such devices that are used to protect the gonads, eye, thyroid and breast tissues should have a characteristic mark signifying that they meet certain standards i.e. CE mark.

Being medical devices, they are issued with operating instructions, details of maintenance requirements and when they should be used¹. It is important that advice is obtained, and written instructions are issued regarding cleaning instructions.

- **Rationale for Non-use - Risk v benefit issues**

The general consensus, with the exception of a particular paediatric patient requiring repeat examinations, is that gonadal and fetal shielding is not necessary^{1,2} and similarly in diagnostic and interventional imaging procedures patient thyroid, eye and breast are also not necessary¹.

This consensus is based on new risk benefit analysis related to the dose levels used in the modern department and re-evaluation of the lifetime stochastic and hereditary risks¹.

Additionally, it is recognised that the patient dose will increase if an additional image is required due to misplacement of the initial shielding in addition to the fact that shielding may hide pathology over a specific region.

- **In beam (direct) and Out of beam (indirect) related to scatter**

The primary radiation (**In beam – direct**) generated from the x-ray tube, used to acquire static or dynamic images should be collimated to the area of interest. The dose and dose rates associated with plain imaging and fluoroscopy procedures, which are delivered to the surface of the patient, will vary depending on the type of examination performed¹. The dose received is also dependent on the duration of exposure and therefore any contact shielding must consider the likely dose (and duration of exposure) of the sources the shielding might attenuate¹.

The greatest potential for a reduction in patient dose will depend on how the radiographer optimises the exposure and undertakes the radiographic examination.

Radiographers therefore have a pivotal and leading role in patient dose management, along with medical physics colleagues, by ensuring that the medical exposure is optimised and performed to the highest standards.

Secondary radiation (**Out of beam – indirect**) is generated by several factors i.e. tube leakage, scatter from the collimator, extra-focal radiation, scatter from irradiated tissue and backscatter from material under the patient. An understanding of these factors in terms of dose contribution is important. The reader is encouraged to consider these facts.

- **Radiographer/Radiological technologist responsibilities**

Training in the safe use of contact shielding is important to avoid misplacement and potential movement before an exposure is made. Those employing shielding should be competent in their use and adhere to employer's written procedures.

Radiographers should be able to communicate clearly as to why shielding is generally unnecessary and explain the dose risk benefit for not using such devices.

Radiographers should be respectful of a patient's choice and be non-judgmental taking into consideration their responsibility to keep the patient safe and to take action to prevent harm. Shielding devices should be used appropriately and accurately positioned to provide efficient protection to the relevant body part¹.

The radiographer/radiological technologist has the responsibility to optimise the radiographic or CT exposure and positioning patients correctly so that the dose is as low as reasonably practicable (ALARP). This way the risk to the patient is optimised without the need for additional shielding¹.

- **Breast, eyes, thyroid and gonads application**

In those situations when the use of shielding is justified care must be taken into consideration to¹: -

- Avoid any discomfort to the patient because of weight and position of the device
- Reduce the risk of the shield moving during an examination
- Reduce any injuries to staff by use of safe manual handling techniques
- Reduce the risk of infection from their use by employing local safe and agreed protocols and procedures

The use of gonadal devices in children can be difficult due to their size and risk of movement. Protocols and procedures for specific examinations related to sex and age should be developed and applied.

Additionally, protocols and procedures should consider both patient consent issues for their use and how to deal with uncooperative patients.

- Fetal shielding – Pregnant patients

Whilst it is not generally recommended to use shielding in the primary beam the International Commission on Radiation Protection (ICRP) report 34⁶ makes recommendations regarding the diagnostic radiology exposures during exposure: -

- Radiography of areas remote from the fetus may be carried out at any point during pregnancy with no additional patient contact shielding, provided that accurate collimation is used and that the equipment itself is adequately shielded. This usually means any examination outside the area between the diaphragm and knees⁷.
- In cases where the pelvis is included in the primary beam, consideration should be given to the use of alternative non-ionising techniques such as magnetic resonance imaging (MRI) or ultrasound. If ionising radiation must be used, then a thorough assessment should be carried out to ensure that exposure to the fetus is justified.^{1,8} ICRP report 34⁶ recommends that if the exposure is justified then consideration should be given to the techniques used to ensure dose to the fetus is kept as low as reasonably practicable, e.g. minimisation of the number of projection taken, strict collimation and partial shielding of the fetus. However, care must be taken to ensure that the images remain of suitable diagnostic quality.

Additionally, consideration must be given in those situations when a pregnant patient requests contact shielding even though the examination is distant from the pelvic region.⁹ In such situations, the potential impact upon the patient's anxiety and welfare should be considered when deciding whether or not to provide shielding. This would usually be in the form of lead/lead equivalent material

draped over the abdomen in accordance with written procedures and at the discretion of the radiographer bearing in mind that this is the last resort. Care must be exercised to ensure accurate collimation and that the shielding must not encroach on the AEC system.¹

- **General radiography**

In the main the use of patient contact shielding is not recommended for both In-beam (primary) and Outside beam protection. ICRP report suggest that consideration should be given to the breast, gonads and thyroid where these organs lie within 5 cm of the primary beam.^{1,10,11} However such use has the potential of obscuring anatomical structures of interest and effectively rules out their potential use. Additionally, such shielding may obscure the AEC device and must not be used if there is a chance of this happening.

The dose to the patient, and hence the risk, is reduced by careful radiographic technique and accurate use of beam collimation to the area of interest to exclude radiosensitive organs from the primary beam. Such use of collimation will reduce secondary radiation and improve image quality.

Radiographic techniques that will reduce the dose to sensitive organs will include: Posteroanterior projections for chest and spinal examination to reduce breast dose; posteroanterior projection of the skull to reduce eye lens dose.

Whilst not generally recommended shielding may be considered for the following situations: Anteroposterior spine for scoliosis using a scoliosis shawl¹ to protect the breasts; for the thyroid, using an anteroposterior projection, which is less than 5cm from the primary beam and its presence will not obscure the AEC¹; adult and paediatric male patients where the gonads are considered less than 5cm from the primary beam.

Shielding of organs Outside the primary beam is not recommended as it will have a negligible effect on the dose received.¹⁰

- **Fluoroscopy – fluorography and permanent image acquisition**

Patient contact shielding is not recommended during fluoroscopy. The use of modern digital imaging equipment with automatic dose rate control including adjustment of x-ray pulse rate, last image hold and beam collimation to the area of interest will assist in reducing patient dose. Patient contact shielding if used

and positioned near the primary beam could interfere with automatic dose rate control causing higher dose rates.

When using C-arm systems similar to those used for cardiology, general angiography and interventional procedures the use of oblique and cranio-caudal angulations can be employed to avoid radio-sensitive tissues. Additionally, care should be given to the field of view and image geometry selection which influences patient dose as well as observing patient dose measurements, in real time, on the image display monitors.

- **Computed Tomography (CT)**

The use of patient contact shielding is not generally recommended^{1,2,3}. Their use in In-beam procedures can lead to complications including a reduction in image quality, due to the introduction of image noise, despite the reduction in dose and if used during a CT localiser scan the patient exposure can be significantly higher than that intended¹.

Care should be focused in optimising the imaging technique dependent on the technological capabilities of the system, i.e., optimum patient positioning¹² using agreed protocols to reduce dose and where appropriate 'In-beam virtual shields' for superficial radiosensitive structures such as the breasts and thyroid gland.

The use of 'Outside beam shielding' for example in the pregnant patient when chest imaging is being undertaken has widespread use¹. Whilst this procedure is rarely undertaken the use of shielding has the disadvantage in that discomfort is experienced by the patient due to the weight of the shielding.

Care also must be taken that their use does not interfere with the CT Automatic Tube Current Modulation (ATCM)

- **Pediatrics**

Both in general radiography and CT procedures optimisation of the exposure, bearing in mind the age and size of the patient is of extreme importance as the primary means of dose optimisation in reducing the dose to radiosensitive organs. The use of patient contact shielding is generally not recommended except for those serial examinations which are used to monitor treatment progress.

- Mammography

The use of patient contact shielding is not recommended. This includes a lead garment placed around the lower torso and thyroid and eye shields. Such use may cause artefacts and repeat examinations.

- Dental

The use of patient contact shielding is not recommended. The design of dental equipment using rectangular collimation, beam aiming devices, paralleling technique and suitable detectors in intraoral radiography is of importance in reducing dose and avoiding the use of thyroid shields^{1,13,14}.

For panoramic or cephalometric examinations, a thyroid collar is not recommended. Instead care should be given to the radiographic technique as its use and poor positioning can lead to anatomy being obscured and repeat examinations necessary.

For some pregnant patients and for psychological reasons only shielding of the abdomen for intraoral radiography may be considered if the x-ray beam is being directed to the abdomen.

- Training in communicating with patients

Radiographers/Radiological Technologists should be trained with communication skills as they explain to patients the reasons why contact shielding is not necessary. This will include knowledge of the typical radiation doses and relevant risks and benefits related to specific procedures. The scenarios set out by the American Association of Physicists in Medicine (AAPM) in their document 'Patient Gonadal and Fetal Shielding in Diagnostic Imaging Frequently Asked Questions' should become familiar and rehearsed as examples³.

References:

1. British Institute of Radiology: Guidance on using shielding on patients for diagnostic applications.
https://www.bir.org.uk/media/416143/final_patient_shielding_guidance.r1.pdf

2. American Association of Physicists in Medicine (AAPM): AAPM Position Statement on the Use of Patient Gonadal and Fetal Shielding
<https://www.aapm.org/org/policies/details.asp?id=468&type=PP¤t=true>
3. American Association of Physicists in Medicine (AAPM): Patient Gonadal and Fetal Shielding in Diagnostic Imaging Frequently Asked Questions.
https://www.aapm.org/org/policies/documents/CARES_FAQs_Patient_Shielding.pdf
4. UK Government Guidance 2019a. CE marking.
<https://www.gov.uk/guidance/ce-marking> [Accessed 07.01.2020].
5. HSE, 2014. Safe Use of Work Equipment. Provision and Use of Work Equipment Regulations 1998. Health and Safety Executive, Approved Code of Practice and Guidance L22, 4th Edition (2014).
<http://www.hse.gov.uk/pubns/books/l22.htm> [Accessed 29.10.2019].
6. ICRP, 1982. Protection of the Patient in Diagnostic Radiology. ICRP Publication 34. Ann. ICRP 9(2/3).
7. HPA, RCR, SCoR 2009. Protection of Pregnant Patients During Diagnostic Medical Exposures to Ionising Radiation. Documents of the Health Protection Agency, RCE-9.
8. HPA, RCR, SCoR 2009. Protection of Pregnant Patients During Diagnostic Medical Exposures to Ionising Radiation. Documents of the Health Protection Agency, RCE-9.
9. Hayre CM, Blackman S, Carlton K and Eyden A. Attitudes and perceptions of radiographers applying lead (Pb) protection in general radiography: An ethnographic study. *Radiography* 2018; **24**: e13–e18
10. ICRP, 2013. Radiological protection in paediatric diagnostic and interventional radiology. ICRP Publication 121. Ann. ICRP 42(2).
11. ICRP, 1982. Protection of the Patient in Diagnostic Radiology. ICRP Publication 34. Ann. ICRP 9(2/3)
12. Touko Kaasalainen, Kirsi Palmu, Vappu Reijonen and Mika Kortensniemi. Effect of Patient Centring on Patient Dose and Image Noise in Chest CT. *Medical Physics and Informatics- Original Research*
13. Rush ER and Thompson NA. Dental radiography technique and equipment: How they influence the radiation dose received at the level of the thyroid gland. *Radiography* 2007; **13**: 214–220
14. Hoogeveen RC, Hazenoot B, Sanderink GCH and Berkhout WER. The value of thyroid shielding in intraoral radiography. *Dentomaxillofacial Radiology* 2016; **45**(5) :20150407.

Resources and useful links:

1. Norwegian advice <https://www.dsa.no/publikasjon/veileder-5-veileder-om-medisinsk-bruk-av-roentgen-og-mr-apparatur-underlagt-godkjenning.pdf#page50>

Note: Links to external websites may change without notice.